THE BEST OF Fine WoodWorking

workshop solutions



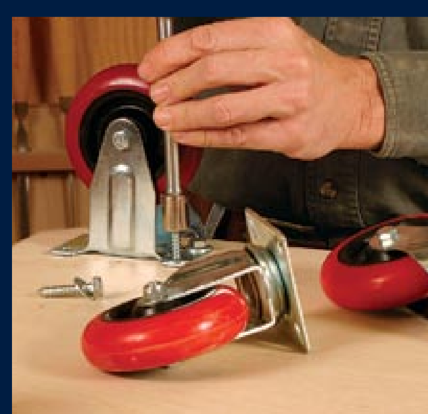
Smart ideas for:

Lumber racks · Workbenches
Shop layout · Rolling storage
Tool cabinets · Dust collection









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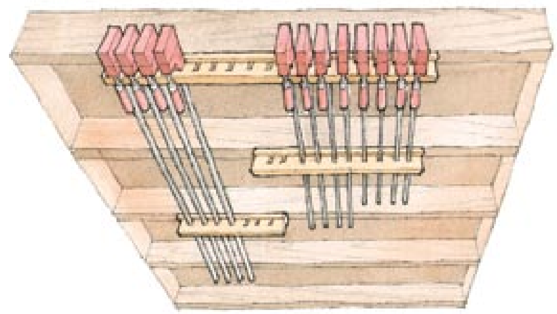
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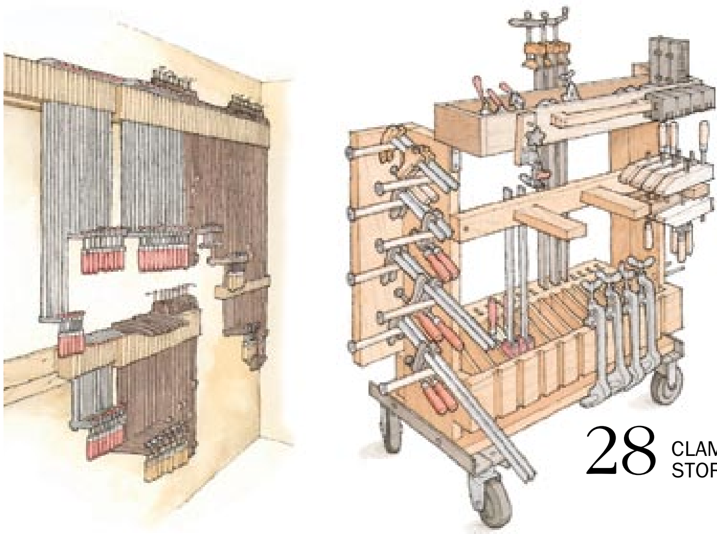
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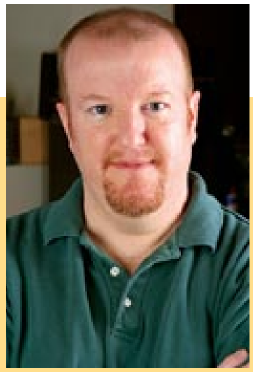
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editor's letter



WORK BETTER, WORK SMARTER

A few years ago, my wife and I were shopping for a larger home to accommodate our growing family. Though charming, our 950-sq.-ft. starter home just didn't work for us anymore, with an exuberant 3-year-old boy already with us and a baby on the way.

Eventually we found a house with all the living room we needed plus lots of storage and closet space. But I was most happy about the home's walk-out basement. Though unfinished, it has easy access, windows, and high ceilings—a perfect place to set up a workshop. So it's no wonder that when asked to take the reins of *Workshop Solutions*, I selfishly jumped at the opportunity. After all, what better way to glean ideas for my own shop than to assemble the best collection of articles on shops, published by *Fine Woodworking* magazine?

Inside this special issue you'll find expert advice on setting up a shop or improving the space you already have. There are nifty ideas for storing lumber and tools, tips on wiring, lighting, dust collection, and flooring, and guides to laying out your tools and shop efficiently. You'll also find plans for sturdy workbenches.

I hope *Workshop Solutions* makes your shop more efficient, so you have more time to enjoy your hobby. Now, if you'll excuse me, I have a workbench to build.

—Tom McKenna
Workshop Solutions editor

Online Extras

For more on outfitting your workshop, visit our Web site. Here's a sampling of the free videos, plans, and articles you'll find at FineWoodworking.com/WS:

VIDEOS

- Contributing editor Roland Johnson demonstrates the portable router table featured on p. 52.
- Online contributor Marc Spagnuolo ("The Wood Whisperer") shows you how to build a dead-flat assembly table.

PLANS

- Woodworker Tim Killen re-created classic sawhorses from an early issue of *Fine Woodworking*. Read his how-to and download the plans.

ARTICLES

- Contributing editor Christian Becksvoort shows you clever ways to design a cabinet that fits all your tools.
- Read how Jeff Miller designed a benchtop workbench for routing, carving, or cutting dovetails.

GALLERY

- See four awe-inspiring shops.



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Workshop Solutions

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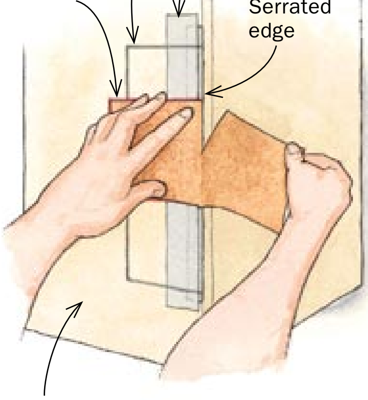
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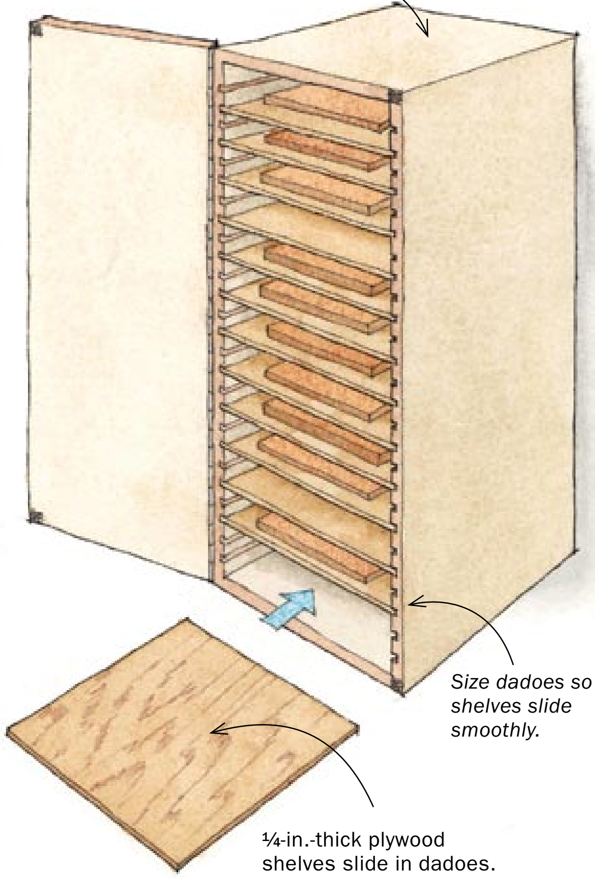
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quick tips

EDITED AND DRAWN BY JIM RICHEY

Sandpaper-storage cabinet with built-in cutter





I have a 12-in.-sq. by 36-in.-tall cabinet with about a dozen adjustable ¼-in. plywood shelves. The shelves ride in dadoes and pull out for access to the contents, making them the perfect place to store sheets of sandpaper. The sheets stay flatter and aren't as likely to curl on humid days.

To make the cabinet even more useful, I saved the serrated edge from a roll of plastic wrap and used duct tape to apply it to the outside edge of the cabinet door. The serrated edge makes it easy to tear full sheets of sandpaper into halves or quarters.

Also, I used two permanent markers (one black, one red) to draw lines on the front of the door. Using the lines as a guide, I can quickly position the sandpaper and tear it to the right size.

—BILL DUCKWORTH, Woodbury, Conn.

Non-skid footholds

One day, by mistake, I dropped a 6-in. self-adhesive sanding disk on the floor of my shop and discovered that the disk provided very solid, nonslip footing. So I placed two of the disks at the front of my tablesaw where I stand. The disks improve my footing, and they're easy to replace when they wear out.

—STEVEN COLEMAN, Tucson, Ariz.

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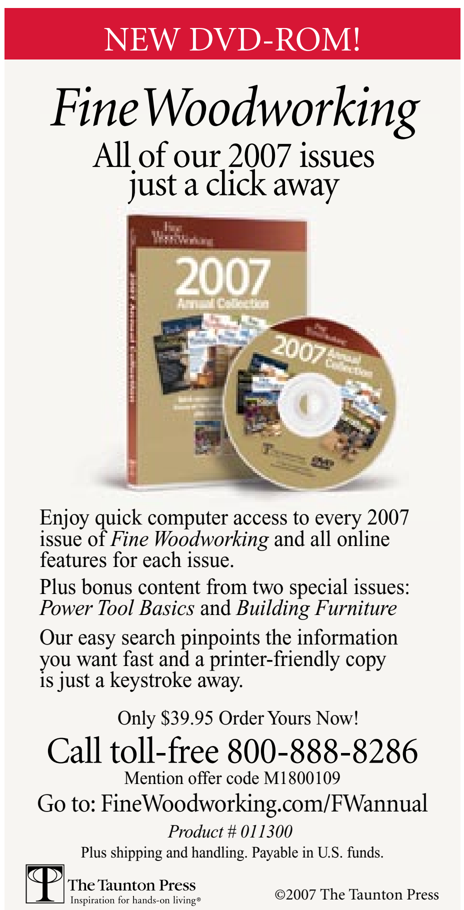
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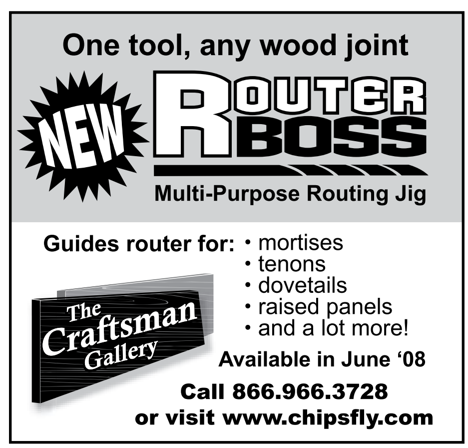


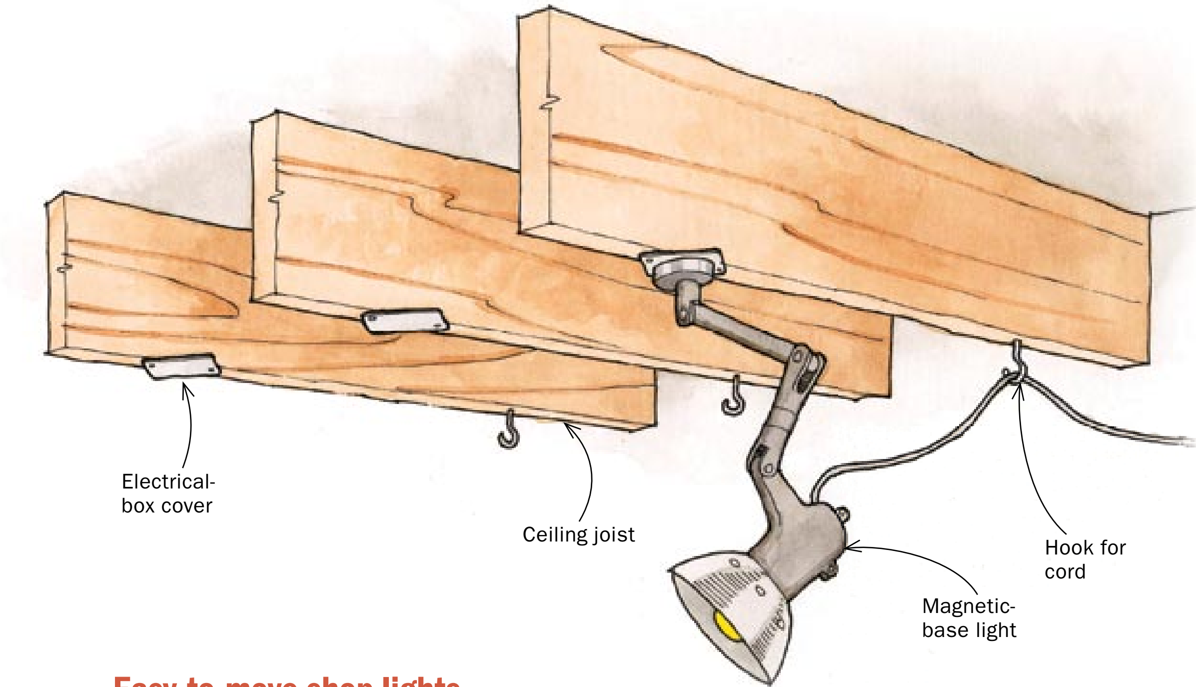












Easy-to-move shop lights

If, like me, you are sentenced to work in a dim basement shop, you know there's always a need for more light. I solved this problem with a few steel electrical-box covers and a light with a magnetic base. I screwed the metal plates to ceiling joists in convenient places (the screw holes are already in the corners of the plate). Now I simply move the light where I need it and stick it to the metal plate. If I need light in a new place, I attach a plate at that location. To keep the extension cord out of the way, I drape it over two or three hooks I have screwed here and there into the ceiling joists.

—REGIS McNICHOLAS, Kennebunkport, Maine

Felt clamp pads

The felt pads made to cover furniture feet, protecting the floor, also make great clamp pads. Sold at most hardware stores, the pads have an adhesive backing that permanently adheres to a clean surface. For pipe clamps, I buy the felt pads in sheets and cut them to fit the clamp heads. For smaller clamps, I buy the felt disks.

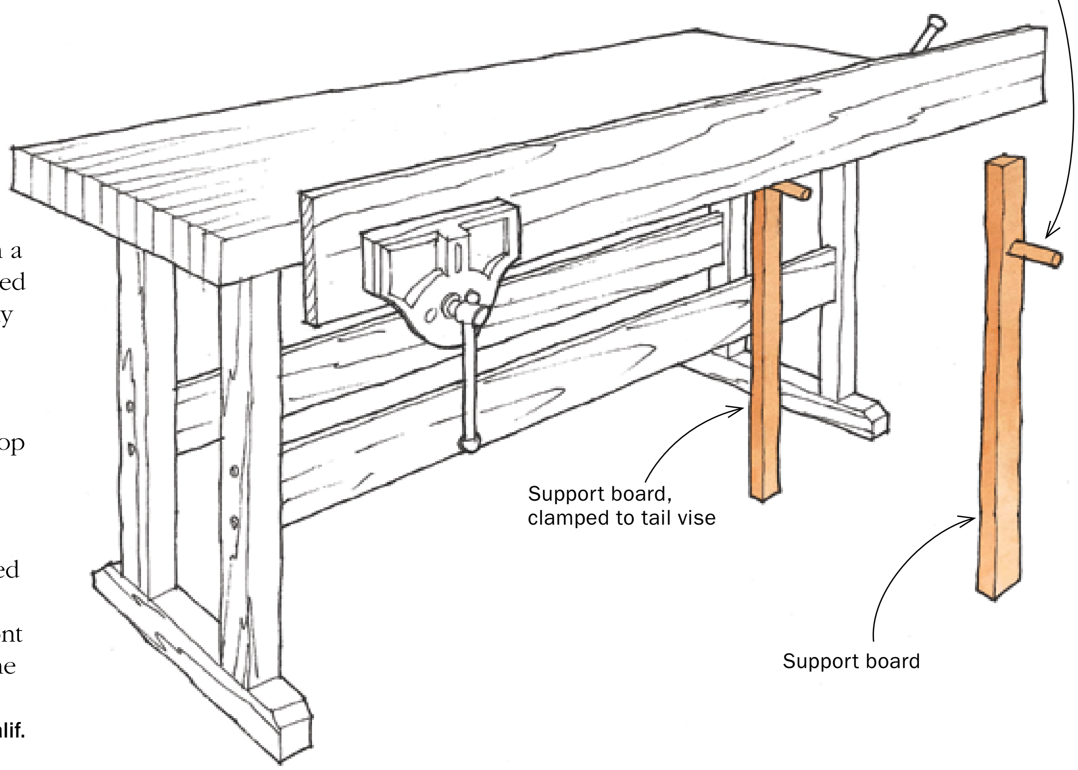
—JIM DION, Lawrenceville, Ga.

Long-board support

A while back when I was wrestling with a large board on my workbench, it occurred to me that the tail vise might come to my rescue. First, I cut a 1½-in.-wide board to a length equal to the height of the workbench. Then I drilled a ¾-in.-dia. hole in the edge of the board with the top of the hole the same distance above the floor as the top of the guide rods in the front vise. Next, I inserted a short piece of ¾-in. dowel into the hole and clamped the board in the tail vise.

I clamp the long workpiece in the front vise with the bottom edge resting on the guide rods and on the top of the peg.

—LEN URBAN, Rancho Mirage, Calif.



Space-Saving Ideas for a Small Shop

Maximize storage and improve workflow

BY MATTHEW TEAGUE

Tales of bad shops are a woodworker's war stories. After living in five houses in seven years, I have plenty of them to tell: ladders under closeted trapdoors that descended into windowless basements, ceilings that were only an inch taller than I am when I stand barefoot, abandoned radiators, wasp nests, snow, water—good Lord, the water—and a hole in the middle of one shop floor (about 2 ft. in diameter and 2 ft. deep) just behind the infeed side of my tablesaw. Oh, yes, I could tell you some stories. But that's not my point. My point is that when I moved into a rented house with a one-car garage—9 ft. wide and 18 ft. long—most of my coworkers wondered how I would fit a shop into such a tight space. But after the shops I'd endured, I felt like I'd finally arrived.



A garage transformed

A few months before I moved in, the 160-sq.-ft. garage had bare stud walls, one electrical outlet, and was littered with enough garden tools to dig a new sea. Luckily, my roommate, who owned the house, was amenable to revamping the space, provided that I pitch in with some of the work. He wanted insulated walls, electricity, and wide barn doors on the front—or at least as wide as possible on a 9-ft. run of wall.

I simply needed a good workspace—desperately. I spent a lot of time planning to condense workspaces and to make sure that machines would work efficiently with one another. Because I only rented the house, I didn't want my shelving and workstations to be built in. I wanted to be able to lift them off the walls and move them out. I didn't want to sink a fortune into cabinets, so I found quick and simple solutions for storage. In the end, all the planning paid off. The former garage became a smoothly running shop—the kind of place where I'd want to spend a Saturday or unwind after a day at the office.

Mapping out the territory

Fitting the major machines—tablesaw, jointer, planer, bandsaw, router table, drill press, and chopsaw—into a room designed to hold a car (a tiny 1920s Model A, at that) was about as difficult as it sounds. I started on graph paper with paper cutouts of all of my tools. Everything had to be drawn to scale because half a foot in such a tight spot could make or break the shop. Large stationary tools demand the most space, so the tablesaw seemed a good place to start.

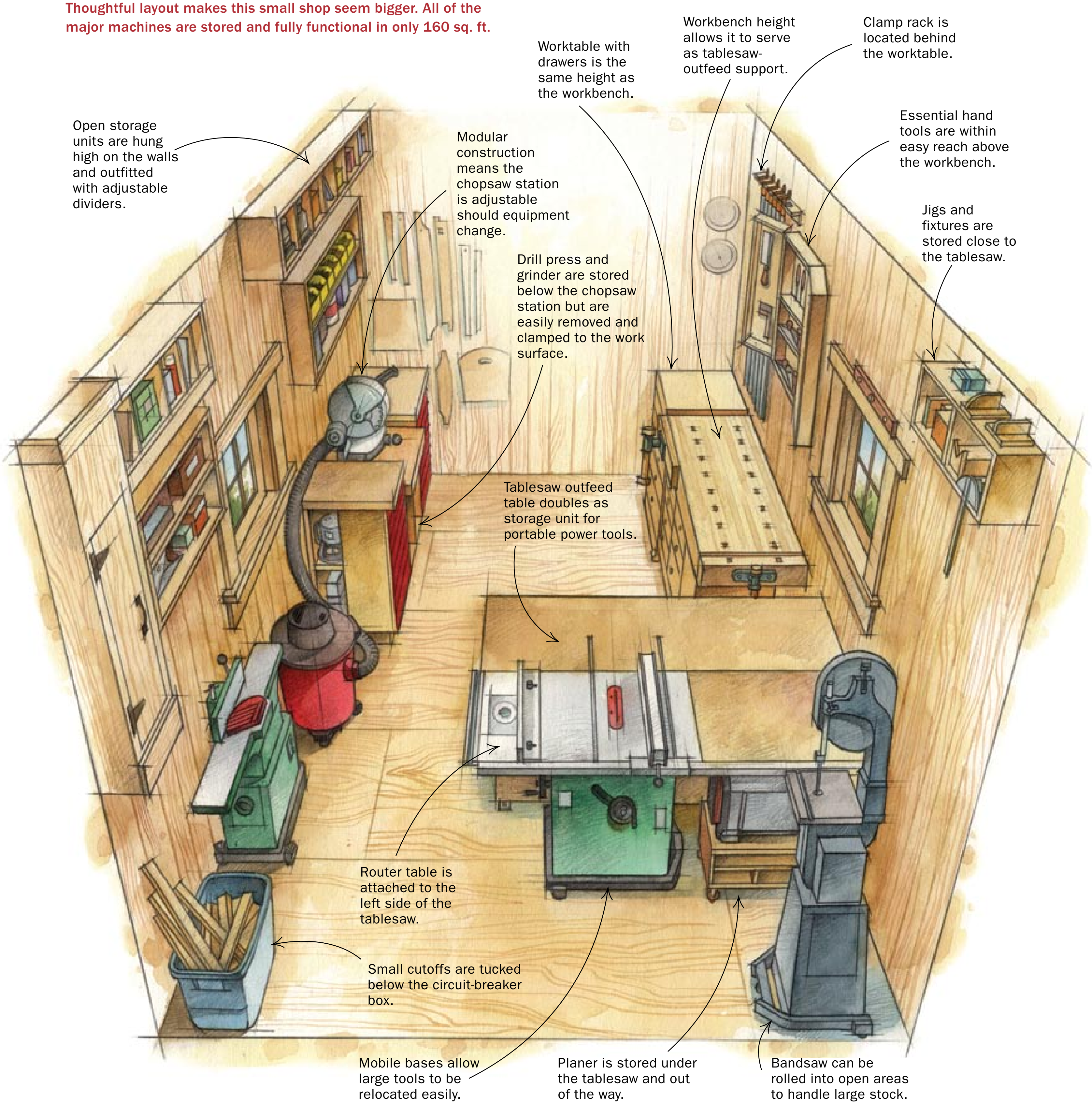
As soon as I put pencil to paper, I saw that I was going to have to forgo my wide 52-in. Biesemeyer fence—there simply wasn't room. I downgraded to a shorter fence by changing out the rails, which at this point only meant lopping off the end of my tablesaw cutout with scissors. I soon saw that large tools had to be mobile; if I left open floor space, any tool could be pulled out easily and put to use. There still were a few wrinkles—like where my router table would go and how I could consolidate my grinder, chopsaw, and drill press into one smooth-running workstation—but after a little thinking and shopping around, I solved those problems, too.

I also kept an eye on the horizontal arrangement of tools and workstations, making sure that the outfeed from certain tools—like my tablesaw and jointer—wouldn't be hindered by workbenches or tabletops. After a few more hours of moving around

Photos: Michael Pekovich; drawings: Brian Jensen

THINKING BIG IN A SMALL SPACE

Thoughtful layout makes this small shop seem bigger. All of the major machines are stored and fully functional in only 160 sq. ft.





Multifaceted workstation. *The chopsaw station also stores the grinder and the drill press and houses two banks of drawers.*



Drawers are like clamps—you can never have enough. *Metal drawers slide in sawkerfs in the carcase. Hardware and fasteners are stored in watchmaker's cases. Drawers for cutting tools are padded.*



A portable workstation. *The drill press and grinder are both stored below the chopsaw but are easily removed and clamped to the work surface.*

the cutouts and positioning the major machines, I started thinking about storage space and drawing quick sketches of the outfeed situation. In the end, I came up with an efficient arrangement in which the major tools took up only about half the square footage of the entire space. It was time to run electricity and build the walls.

After cleaning the garage of all its old tools and odds and ends, my roommate and I hired an electrician to wire the space. We placed the outlets 44 in. up from the floor—just above bench height—and ran them every 4 ft. We also dropped in four 220-volt outlets conveniently located to reach the beefier machines.

We insulated the walls and hung T-111 siding, which is stronger than drywall and does a better job of holding tool cabinets. The light color of the siding opened up the space, and the rough wood surfaces gave the shop a warm, inviting feel. We then built and hung the barn doors.

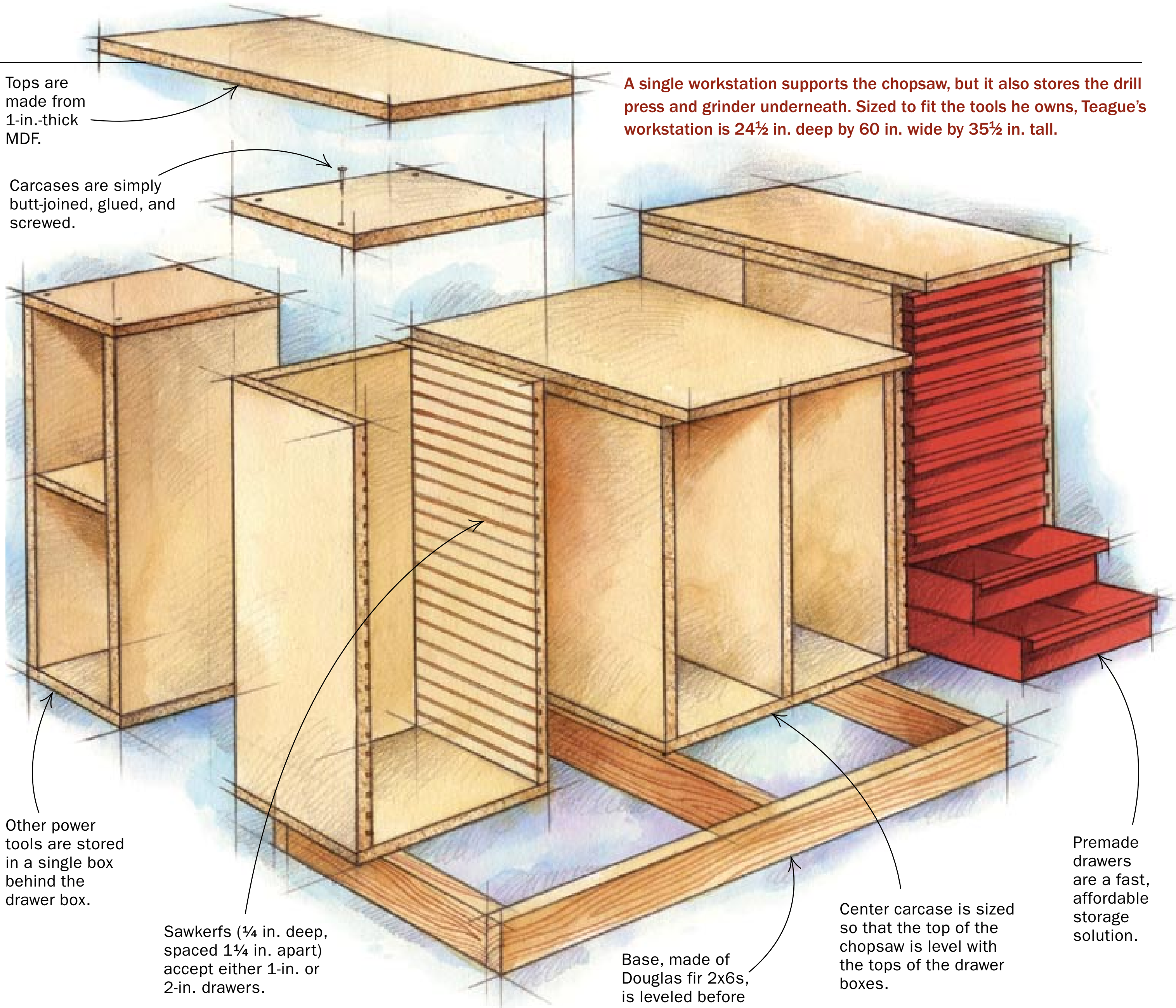
The existing wood floor in the garage would have been nice underfoot, but it was too old and uneven to allow my heavy mobile tools to move easily. We laid down plywood flooring over the existing wood floor and covered it with a few coats of water-based polyurethane.

I have to admit I was shocked that everything worked just as it had on paper. Now I was ready to roll in the machines.

Large tools rest on mobile bases

My tablesaw was positioned about 4 ft. inside the doors, leaving enough space on the left side of the saw for my jointer. And because I put the jointer on a mobile base, I could move it to a convenient place to joint long boards. My lunchbox planer was relegated to the cubbyhole below the right-hand side of my tablesaw. It saved floor space, but because the planer is light and kept on a shopmade mobile base, its usefulness was not limited.

One big hiccup always had been my router table. It made sense to save space by housing the router table in the tablesaw, but most models mount on the right side of the saw—a setup I'd never been happy with. And with the right side of the saw against the wall, where it clearly had to go, I couldn't stand in front of the fence when routing—doing otherwise always had seemed unsafe. Still,



A single workstation supports the chopsaw, but it also stores the drill press and grinder underneath. Sized to fit the tools he owns, Teague's workstation is 24½ in. deep by 60 in. wide by 35½ in. tall.

Workstation assembles easily



1 ***Set the boxes in place.*** *The main carcase is centered on the base and screwed into place.*



2 ***Keep the carcases flush and secure.*** *Clamps hold the drawer box in place while it is screwed to the base and the center carcase.*



3 ***Exploit every inch.*** *Storage boxes are set behind the drawer boxes and screwed in place.*



4 ***Use a thick top.*** *The 1-in.-thick MDF is coated with a few washcoats of shellac and will stand up to heavy work.*

a stand-alone router table was going to take up more room than I had to spare. Browsing through catalogs and online, I found a left-mounted router table made by Bench Dog (800-786-8902; www.benchdog.com).

The left-mounted router table worked great, but because my tablesaw table is larger than average—even for a cabinet saw—I had to redrill a few holes in the top of the tablesaw and install spacer blocks to make the router table fit. But the afternoon's work was well worth it. Not only did the table save space, but it also worked better than any free-standing router table I'd ever had.

As planned, the bandsaw rolled into the front corner of my shop, just behind the tablesaw. It was close enough to the doors that I could roll it out and use the open doorway as outfeed space as needed. But this is only in a pinch. For most of my woodworking—chairs, small tables, and chests of drawers—the bandsaw had plenty of room.

This arrangement took care of the major stationary tools, and I still had two long walls for the chopsaw station and the workbench. I ended up designing and building a modular chopsaw station to house not only my chopsaw but also my drill press and grinder. It holds a bank of ready-made drawers and leaves a few cubbyholes in back to store routers and such.



A place for everything. *Space in the rafters is used for storing—and even drying—lumber.*

Using the tablesaw's outfeed table as storage for power tools gave me plenty of open floor space, while exposed rafters worked well as lumber racks. Once the major machines were in place, the rest of the shop almost designed itself.

Condensed work areas

One key to working in a small shop is to condense your workspaces for both economy and ease. I wound up building units out of medium-density fiberboard (MDF) to handle tablesaw outfeed, as well as my chopsaw, grinder, and drill press.

While I would have loved a nice, long tablesaw-outfeed table that could handle large sheet goods, there was hardly room. Ninety-nine percent of the time, the 2-ft.-wide outfeed table would provide all of the support I needed. When working with 4x8 sheet goods, I cut them to rough size with a circular saw, then trimmed them at the tablesaw. The outfeed table did double duty as a storage station and assembly table.

The outfeed table was assembled with knockdown fasteners so that the whole workstation could be taken apart for easy transport when I move. I installed a 1-in.-thick MDF top and covered it with a few coats of shellac, which provides a moisture barrier and makes the MDF less prone to scratches. Four 4-in. lag bolts serve as levelers, making it easy to



HAVE WHEELS, WILL TRAVEL



Buy a mobile base. *Storing the bandsaw and jointer on mobile bases allows Teague to pull them out into the open when he has to handle especially long stock.*



Or make one yourself. *Teague's planer base is nothing more than an MDF box with locking casters screwed to the bottom. It includes shelves as well.*

bring the outfeed table flush to the tablesaw. It would have been nice to have a sliding compound-miter saw, a floor-standing drill press, and a permanent grinding station that was always ready to go, but working in a small shop meant I had to accept some sacrifices. And because I was working on a budget, I couldn't upgrade all of my tools—not to mention that my tools had always worked well for me.

After a bit of head scratching, I devised a way to combine my chopsaw, drill press, and grinder into one workstation that takes up only a small footprint and works smoothly. Built box by box, the modular workstation is extremely flexible. Should I replace any of my tools, I'll simply change out one of the units and replace it with a new and correctly proportioned carcase.

Well-organized storage

The bank of drawers on my chopsaw station provides more than 30 sq. ft. of storage space. I ordered premade metal drawers (around $7 apiece) from Lee Valley (800-267-8735; www.leevalley.com). Installation was simple. All I had to do was build a box and run sawkerfs every 1¼ in.; the 1-in.- and 2-in.-deep drawers slide into place and can be rearranged however I like. The drawer-box carcase became the basis around which I built my chopsaw stand.

Online Extra

For a free plan of the outfeed table below, go to **FineWoodworking.com/WS.**

I built all the MDF units above my bandsaw, jointer, and chopsaw station using an ultralight MDF rather than the weightier MDF of my outfeed table—the weight helps in that situation, but it isn't necessary on the wall. The light stuff is also much more pleasant to use.

Above both the chopsaw station and jointer, I installed simple plywood shelves to hold screws, router bits, and drill bits. Staying organized is especially important in a small shop. I used watchmaker's cases from Lee Valley to hold screws and other hardware (see top right photo, p. 16). With just a glance, I can find what I'm looking for.

I was bent on using quick methods and economical materials, but when it came to my workbench, it was hard to accept compromise. I had inherited an old workbench top from a friend, who had inherited it from another friend, who'd been given the bench by a boatbuilding pal many years ago. I built a maple base for it and installed the same drawer boxes I'd used on an earlier bench. To store my favorite chisels and planes, I made a simple cherry wall unit with two box doors.

Though the garage required a fair amount of renovation, the shop came together quickly and worked better than I ever would have imagined. A good workshop should be simple and sensible but designed with an eye toward efficiency. A sensible shop makes you work better and smarter. The best part is that when I moved back to Nashville, the shop was easily disassembled. □

Matthew Teague is now working wood in a bigger shop in Nashville, Tenn.



ONE TABLE, MANY USES

The outfeed table not only provides support for the tablesaw, but it also stores power tools and other materials. The shop vacuum can be used for dust collection at the tablesaw. The 1-in.-thick MDF top also serves as a sturdy surface for assembly. Lag bolts in the base make it easy to level the table.



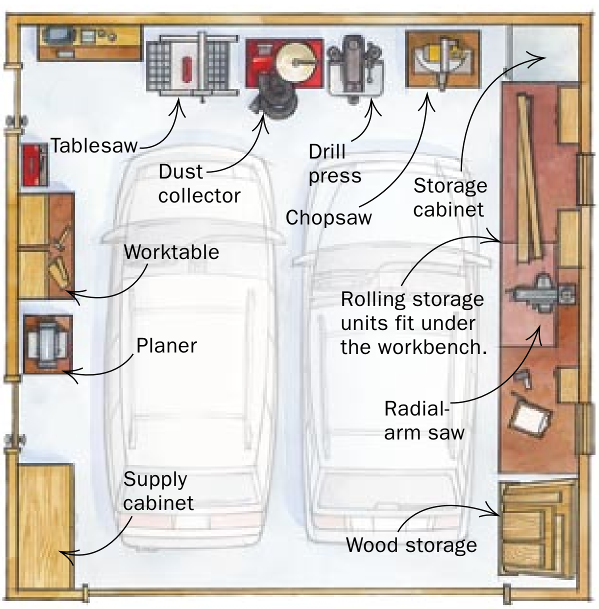
Condense workspaces. *A router table that mounts on the left side of the tablesaw saves valuable floor space and still leaves plenty of room for moving around.*



Roll-Away



With wheel-mounted tools and cabinets, a two-bay garage accommodates cars and woodworking



TWO CARS AND A HOBBY

The 23-ft.-square space is a workshop by day and a garage by night. A workbench spanning one wall houses rolling cabinets used for storage and as tool stands, work surfaces, and infeed and outfeed tables.

After many years living in central Florida, I received an invitation to relocate to Tucson, Ariz. Having been an active woodworker for 18 years, I placed adequate shop space high on my list when it came time to buy a home. While it would have been nice to find a house with a separate workshop, my wife and I settled on one with a spacious two-car garage.

This presented me with a challenge: create an efficient and comfortable workshop that could accommodate big projects but still make room for the family cars. So I began laying out a plan to share my tablesaw with my parking space.

I wanted to keep at least one car in the garage at night, even if a half-finished project occupied floor space. The flexibility to park two vehicles in the garage on occasion also was essential. The challenge was balancing these requirements with the elements of a good shop: one that is attractive to work in, easy to clean, and has plenty of organized storage.

Making do with limited space

To have plenty of workspace and be able to cut long boards with my radial-arm saw, I knew I would build a long workbench along one wall. I began sketching idea after idea, looking for inspiration in books, magazines, and on TV woodworking shows.

While paging through magazines, I came upon an article for a roll-around tool-storage cabinet designed to be tucked under

Photos: Matt Berger

Workshop

BY BILL ENDRESS

one wing of a tablesaw. I realized I could use a similar concept, with roll-around cabinets beneath the workbench to store tools. Built to well-planned heights, the rolling cabinets could serve as infeed and outfeed supports for the tablesaw, planer, and miter saw. Work areas also could be adapted to accommodate different projects just by rearranging the cabinets.

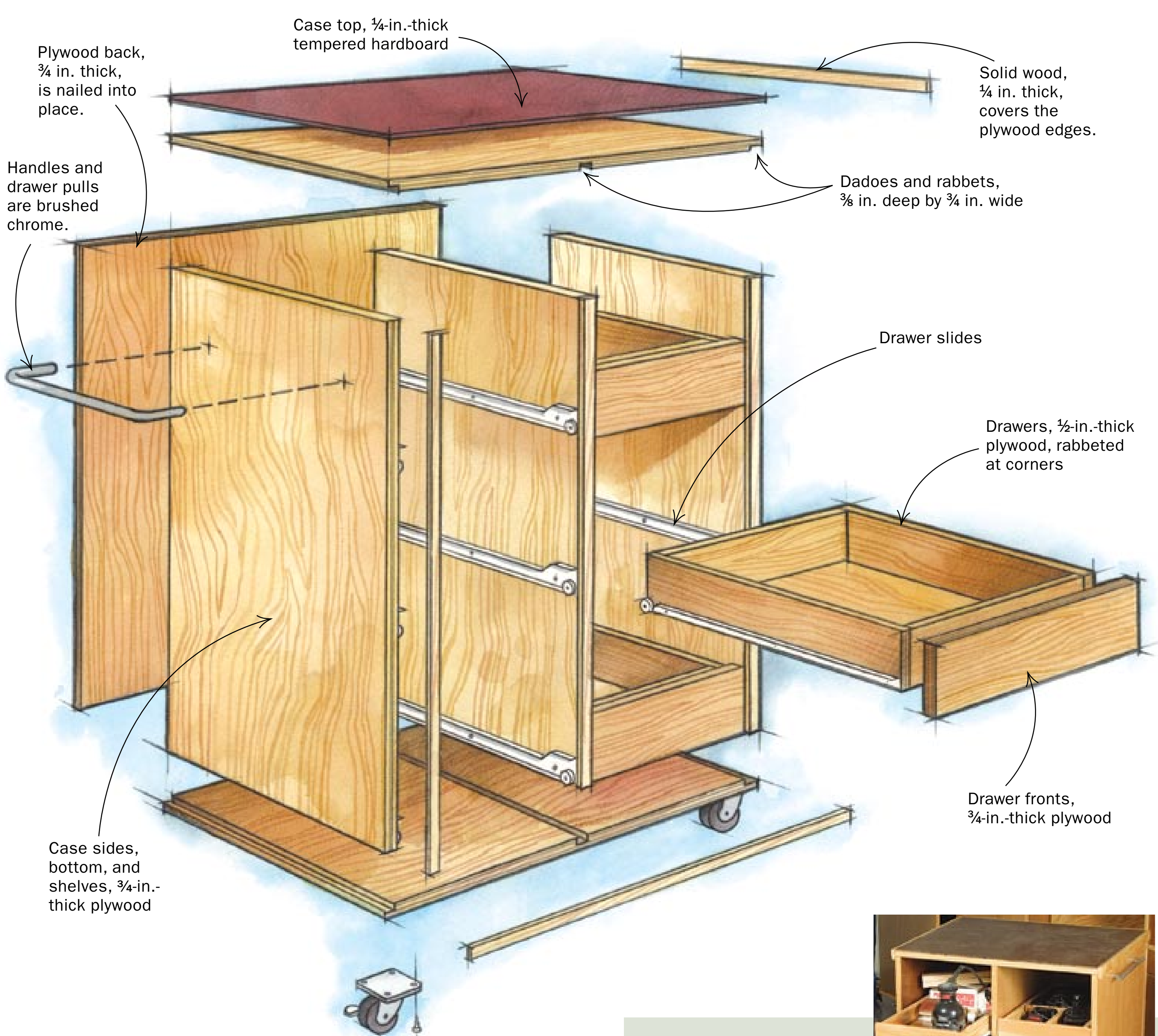
Workbench serves as a garage for rolling cabinets

Constructing the main workbench was the first task. Because of space limitations, I built it in two sections bolted together. One section is 8 ft. long, and the other is 6 ft. long. After some measuring of tables and kitchen cabinets, I determined that a work surface 30 in. deep and 37 in. tall would be most comfortable. The workbench was fortified with a 2x4 frame to support the substantial weight of the radial-arm saw. I also installed two electrical-outlet strips on the bench, one on each side of the saw. They're mounted along the front edge to keep power-tool cords from extending across the top of the surface.

Once I knew the workbench measurements, it was easy to back out the dimensions for the rolling cabinets. To keep it simple, the



BASIC CONSTRUCTION OF ROLLING CABINETS



Each rolling cabinet has the same overall dimensions: 26 in. deep by 22 in. wide by 32½ in. tall (the chopsaw, planer, and scrollsaw cabinets are shorter but follow a similar construction method). Locking swivel casters account for 3 in. of the height. The basic construction allows for variations in the placement of drawers and shelves. Each cabinet is constructed from ¾-in.-thick plywood and finished with two coats of water-based varnish.

Configure the cabinet for various uses

While confined to set dimensions, Endress designed the rolling cabinets with various arrangements of shelves and drawers so that each one serves a different purpose.



Sliding shelves store power tools visibly and in reach. *Endress built two of these cabinets—one with a left-facing handle, the other with a right-facing handle—to form a large surface when side by side.*

Drawings: Brian Jensen

cabinets follow the same basic design but are configured differently, according to their functions.

Some cabinets have drawers, some have shelves, and some are built to hold large power tools. All of the cabinets roll on swivel casters. Handles are attached to the cabinet faces so that they can be maneuvered around the garage.

The first four cabinets provide adequate storage for my hand tools and small power tools. Their height is consistent and makes them ideal to serve as infeed and outfeed tables for my miter saw, planer, and tablesaw. But I also needed storage for power tools.

The scrollsaw fits below the workbench on a low, rolling cabinet that is just the right height to use the saw while sitting comfortably in a chair. The router-table cabinet also is on wheels. The table is equipped with a router lift. The lift is offset from the center of the work surface, leaving room for drawers on one side of the cabinet to hold router bits, collet wrenches, and a laminate trimmer. Two more drawers below the router are large enough to hold another router, associated tools, and auxiliary baseplates.

Following the same design, I built rolling cabinets to hold my planer, miter saw, and tablesaw. Rather than getting stored out of sight, these cabinets fit along the walls of my shop and can be moved easily. The cabinets for these tools also have plenty of storage for any accessories.

Online Extra

To see the roll-away workshop in use, go to **FineWoodworking.com/WS.**

Dust collection is easy to incorporate—The only tool in the shop that doesn't have dust collection built into its cabinet is the miter saw. Try as I might, I haven't come up with a good dust-collection system that allows me to store the cabinet against the wall. When using this tool, I usually set it up by the garage door so that the dust generated is thrown outside the shop.

To keep the shop clean, I settled on a 1-hp mobile dust collector that can be attached to one tool at a time, and it has been adequate so far.

Wheels roll in any direction and lock securely—I used four 3-in. locking swivel casters (available at hardware stores) on each rolling cabinet, which enables them to move in any direction.

When all four wheels are locked, the cabinet becomes a stable platform. Unfortunately, due primarily to its weight, moving and locking my tablesaw into place on its low cabinet was a struggle. It always seemed to go in the opposite direction I wanted it to go. On a whim, I decided to try higher-quality, heavy-duty casters from Woodcraft Supply Corp. (www.woodcraft.com). What a difference! Not only can I move my saw with little effort, but the locking mechanism also is much easier to operate.

Wall cabinets reduce clutter

After taking up as much space as I could afford on the ground, I looked to the walls for more storage. I designed the wall cabinets to accommodate my work habits. I did not want deep cabinets, as things tend to get shoved to the back and become lost. I wanted my cabinets just deep enough to hold racks of storage bins. I also did not want them so high that a ladder would be necessary to access the top shelves. This led to a final dimension of 8 in. by 30 in. by 30 in. for a double-wide cabinet, and 8 in. by 15 in. by 30 in. for a single-wide cabinet.

Cars and projects live in harmony

When I first came up with the idea of a small garage shop based on a mobile storage concept, I wondered how it would work out. After using the shop for a few years, I continue to be amazed at how easy and how much fun it is to work here. All of my requirements were met, including the ability to park two vehicles in the garage when the shop is not in use.

As with any shop, there are lessons learned for building the next one. In hindsight, it would have been a good idea to plumb the workbench for dust collection and compressed air. But overall I am quite pleased. If I do add new tools to my shop, I'll build rolling cabinets designed specifically for them. ☐

Bill Endress is an aerospace engineer in Tucson, Ariz. In his spare time, he works wood in his two-car garage.



Shallow drawers hold hand tools. *An open area below the top of the cabinet keeps tools within reach but out of the way. The cabinet's top has enough overhang for attaching clamps.*



There's no such thing as too much storage. *Two tall, open shelves are used for storing large objects such as a toolbox, benchtop grinder, and belt sander.*



Scrollsaw sits at a comfortable height. *The scrollsaw is mounted to this low rolling cabinet so that it can fit below the workbench when not in use. However, it's just the right height to use while sitting comfortably in a chair.*



Router table holds parts and accessories. *This rolling router table is equipped with a router lift. The lift is offset to accommodate drawers, bits, and accessories. Dust-collection ports are built into the fence and cabinet back.*

GET **ORGANIZED**

Lumber Storage Solutions



Shopmade carts and racks keep material organized and accessible

BY ANDY BEASLEY

I once read that the idea of infinite space was perhaps the most difficult concept for the mind of man to grasp. I beg to differ. Anyone who has ever tried to create a functional shop knows that fitting it into a finite space is a far more challenging proposition. Once all of the necessary tools, materials, and that last bottle of glue have been shoehorned into the workshop, you can find yourself on the outside looking in.

When building my shop several years ago, I experimented with different layouts until I found the one that worked best for me. I've been happy with the result, largely because the lumber-storage system I developed added considerably to the efficiency of my shop while taking up little of its finite space.

Wall rack handles the long stuff

The centerpiece of my storage system is a horizontal rack along one wall. The rack is exceptionally stable, and the various levels hold a lot of material within a small footprint. The design is straightforward, the

Photos: Tom Begnal; drawings: Jim Richey

Wall rack for lumber

With stanchions spaced 32 in. on center, the rack can be made to fit a wall of any length and height.



Lumber at the ready. *A wall-mounted rack keeps lumber flat, dry, and organized, yet out of the way.*



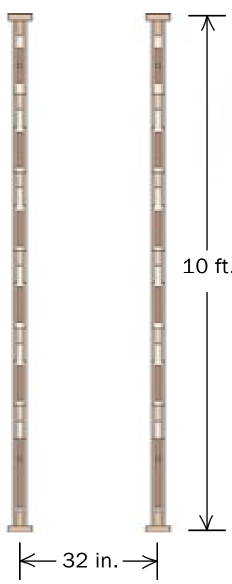
Simple mounting system. *Lumber rests on a series of support arms that are bolted to stanchions.*

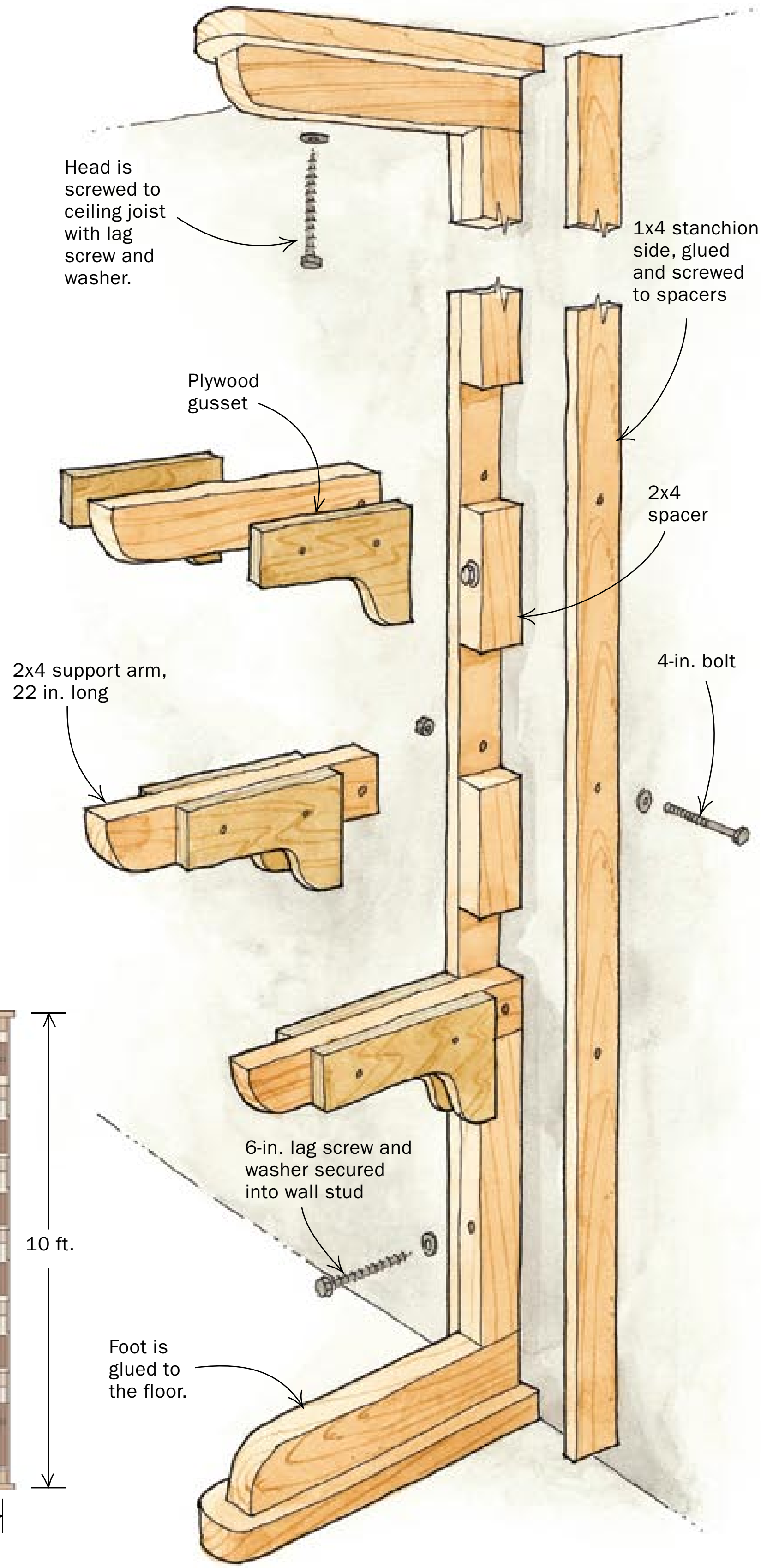
materials are relatively inexpensive, and the construction time is short.

I frequently store 16-ft. lengths of molding, so I decided to install six vertical stanchions to provide the necessary horizontal space. The 2x6 studs in the shop wall are on 16-in. centers; I installed a stanchion on every other one, or 32 in. on center. These stanchions are merely lengths of 1x4 pine, glued and screwed to 2x4 spacers. The spacers add stiffness, create pockets for the support arms, and provide a solid attachment point for the lag screws that mount the assembly to the wall.

Although the stanchion assembly is simple to build, it helps to choose stock that is straight, without bow or twist. Gluing and screwing the pieces together on a level floor is an easy way to keep them true.

This rack is designed to support considerable weight if it is mounted securely to a sturdy wall. To attach the stanchions to the shop wall, I first marked the locations of the electrical wires in the wall so that I could give them a wide berth. Then I secured the stanchions with



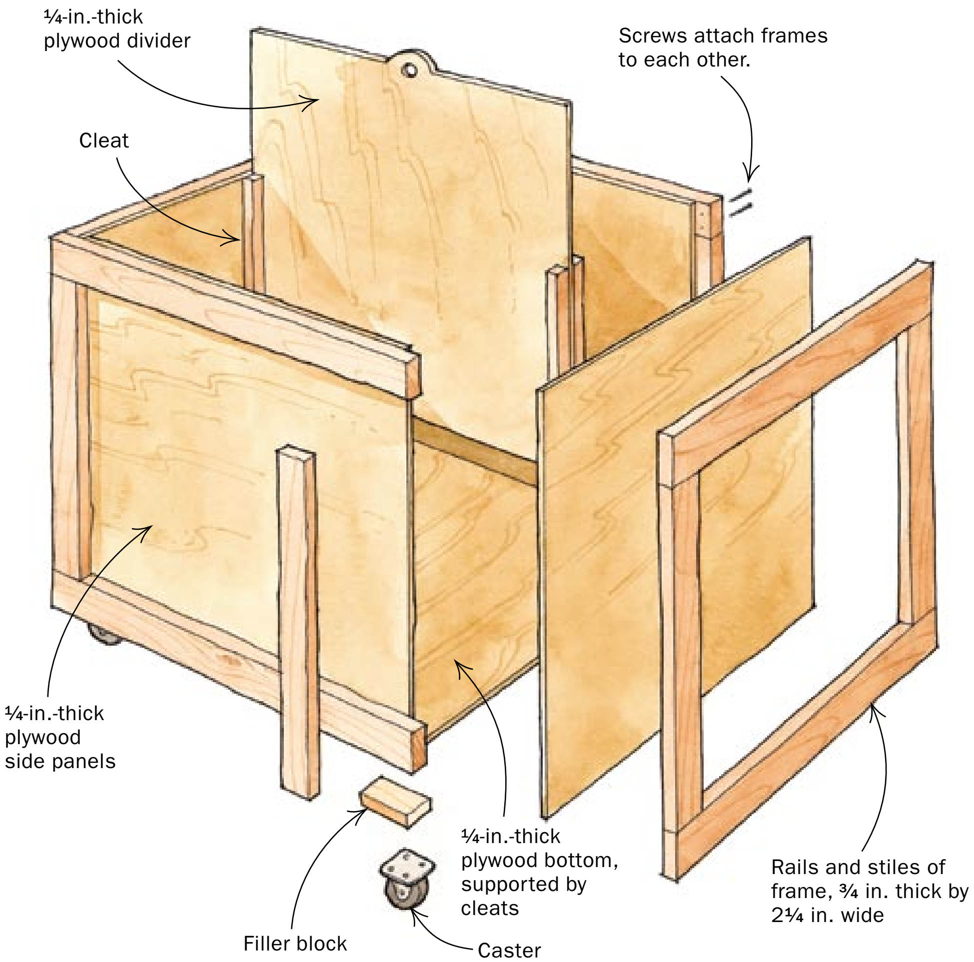




Rolling cart adds convenience. *A framed plywood box on wheels provides the perfect place to store offcuts.*

Cart for lumber offcuts

Simplified frame-and-panel construction means the cart assembles without much fuss, yet has plenty of strength.



6-in. lag screws through the spacer blocks and into the wall studs.

This rack can be attached equally well to a concrete wall as long as heavy-duty masonry anchors are used. The small, plastic expanding anchors used to hang pictures on cinderblock walls won't provide the necessary pull-out resistance. For similar reasons, don't mount this rack to a hollow gypsum or paneled wall.

The head and foot of each stanchion help prevent twisting, stabilizing the rack when it's under load. The head is screwed to a ceiling truss, while the matching foot is glued securely to the floor.

The horizontal support arms do the hard work. They're made of 2x4s with ¾-in.-thick plywood gussets screwed to each side. I angled the arms upward 2° to keep material from sliding off, and I rounded the protruding ends to soften any inadvertent collision between my head and one of the arms. My wife painted most of the rack before installation. However, to prevent lumber from picking up unwanted stains, the top edge of each arm was left unpainted.

I started at the top row and installed each arm by drilling a hole through the stanchions and the inner end of the arm. A ½-in.-dia., 4-in.-long bolt secures each arm. In the future, though, should I decide to change the elevation of the arms, the oversize pockets in the stanchions give me the ability to drill a new bolt hole and shift each arm to a new location.

Roll-around cart for short pieces

Besides death, taxes, and slivers, I think the accumulation of lumber offcuts is about the only thing woodworkers can take for granted. The woodstove can handle just so much, and besides, that peanut-size chunk of walnut may come in handy someday. Owning up to my pack-rat tendencies, I built three storage carts for offcuts that fit in the unused area under the bottom shelf of the wall rack. I left the rest of that area open for future storage needs.

The carts are simple boxes on casters. To stave off the chaos that would ensue if I just threw scrap into the carts, I installed removable dividers, which allow for a rough sort of organization. By adding a removable plywood top to one of the carts, I immediately had a mobile workbench.

Vertical box stores sheet goods in minimal space

I'd initially planned to store sheet goods flat or on some sort of horizontal cart, but I discarded those ideas because they ate up too much floor space. The obvious answer was vertical storage. Holding 15 to 20 sheets, the rack I constructed is little more than a doubled-up plywood bottom, a few 2x4 posts, and a plywood top.

Because there's little outward pressure on this type of rack, it can be attached to a wall with either nails or wood screws. To this simple structure, I added a few user-friendly features. The 2x4 spacers on the side walls of the rack give me some

Rack for sheet goods

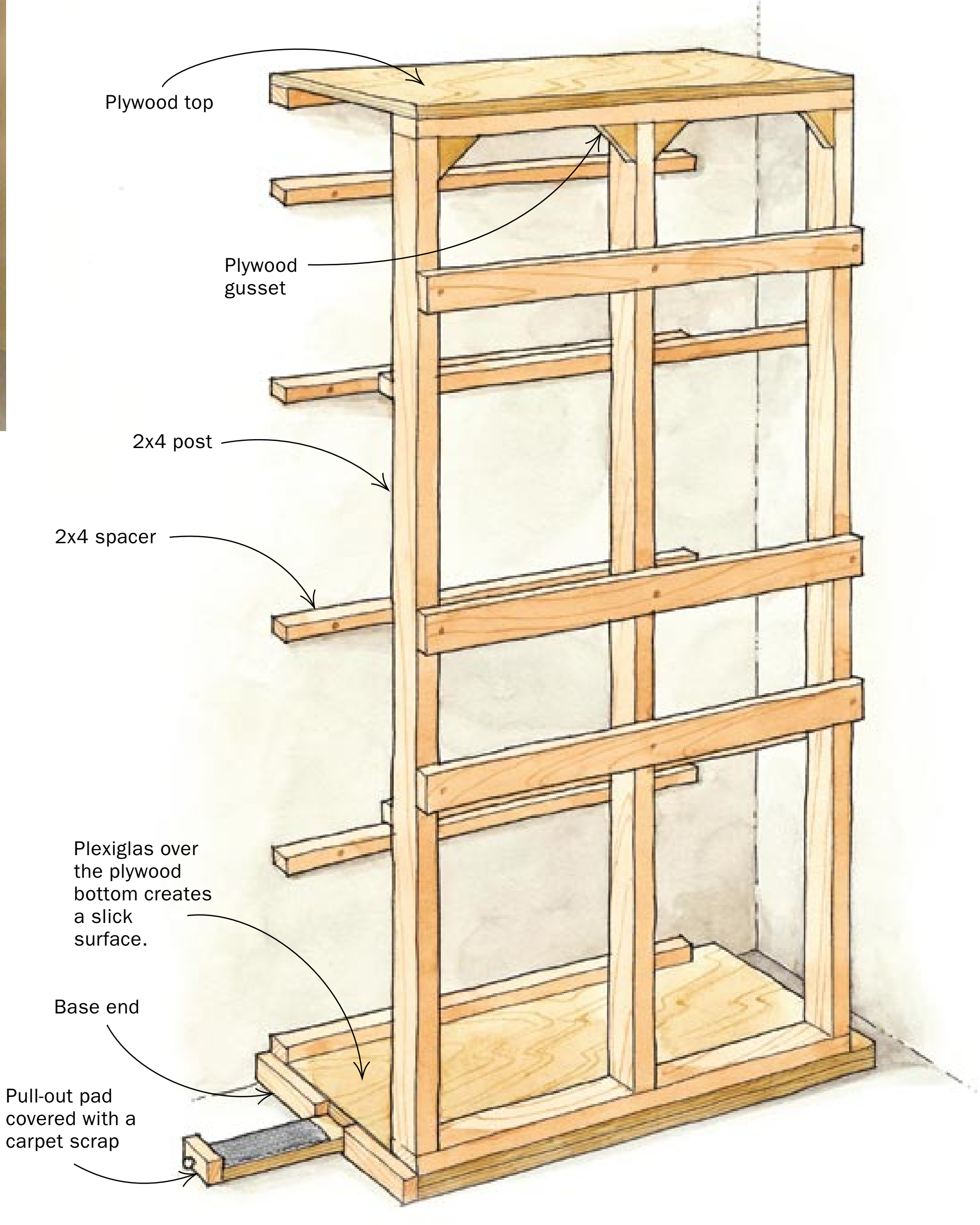
Stored vertically, sheet goods like plywood and MDF take up little floor space and can be accessed with ease.



Choose and use. *This vertical rack makes it easy to flip through the sheets and pull one out without damaging it.*



Protective pad. *The outside bottom corner of sheet goods gets some protection from damage, thanks to a pull-out pad.*



finger room when I want to withdraw a sheet that's located near the edge. A layer of Plexiglas covering the plywood bottom makes sliding even the heaviest sheet a breeze. And because I don't relish the idea of dinging the corner of an expensive sheet, I installed a pull-out pad to protect the pivoting corner as I load or unload material. To squeeze the last bit of utility from the rack, I use the outer frame as a place to hang levels, squares, and cutting jigs.

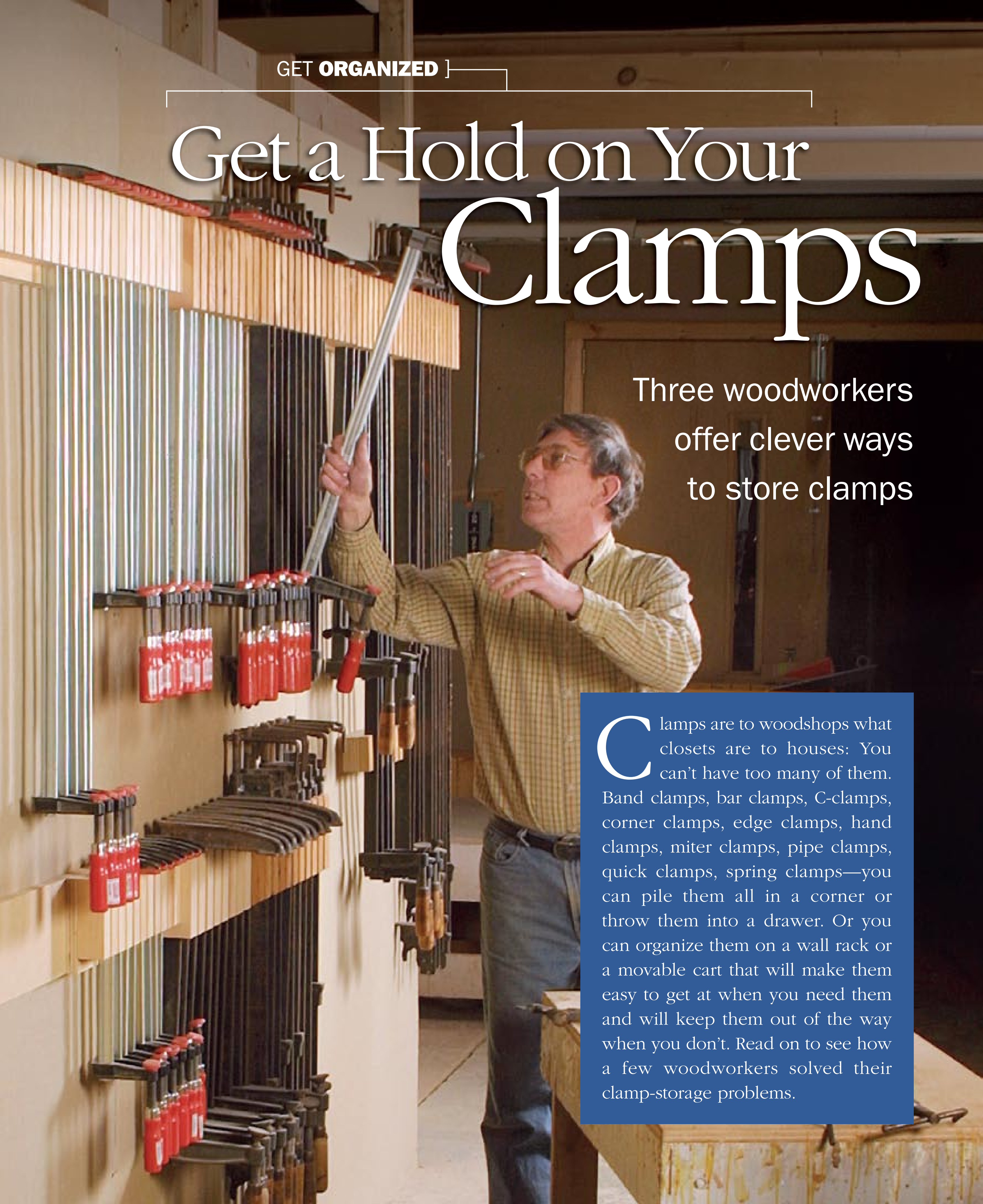
Everything in its place

Just as a closet won't pick up that shirt you've thrown over a chair, a lumber rack won't do you any good if you don't use it. I've developed habits to keep the shop both uncluttered and efficient. At the end of each day, I select the offcuts I intend to keep. Any boards shorter than 24 in. go into the roll-around lumber cart; longer pieces are stored on the horizontal rack. I used to put these leftovers anywhere, but each time I brought in a new load of boards, I had too many little things to rearrange before I could place the incoming material on the rack.

When I return plywood or sheet goods to the vertical rack, I always write the new width on the exposed edge. That prevents miscalculations when I'm reviewing the material I have on hand for a project, and I don't have to slide out a piece to check its width.

This storage system works exceptionally well. Now, when work is going smoothly and all my materials are stowed neatly away, I sometimes let my mind wander to those minor problems of infinity. □

Andy Beasley works wood at his home near Hillside, Colo.



Get a Hold on Your Clamps

Three woodworkers offer clever ways to store clamps

Clamps are to woodshops what closets are to houses: You can't have too many of them. Band clamps, bar clamps, C-clamps, corner clamps, edge clamps, hand clamps, miter clamps, pipe clamps, quick clamps, spring clamps—you can pile them all in a corner or throw them into a drawer. Or you can organize them on a wall rack or a movable cart that will make them easy to get at when you need them and will keep them out of the way when you don't. Read on to see how a few woodworkers solved their clamp-storage problems.

Wall Rack

B Y J O H N W E S T

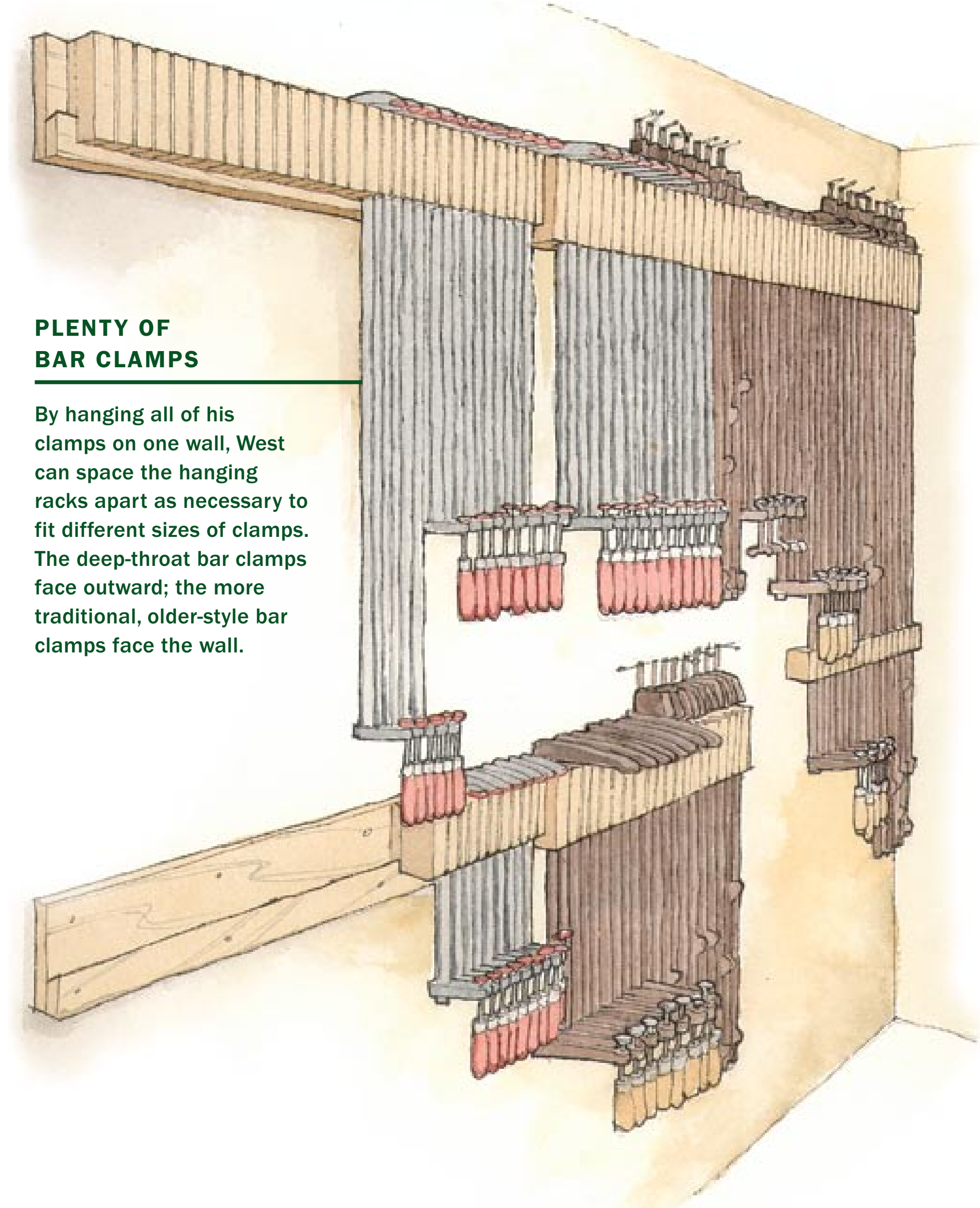
Versatile rack stores clamps of any length

After I moved to a smaller shop, I had to figure out an efficient way to store my large collection of bar clamps and hand clamps. I decided against a fancy rolling rack because the floor space it would require is too dear. I wanted my clamps near the area where large glue-up projects are done, but I also wanted to keep them out of the way when they're not needed. The solution was to hang the clamps on a wall.

The racks I designed are quite simple, and they can be used to store a variety of different-size clamps. First, securely fasten a ¾-in.-thick hanger strip (plywood or medium-density fiberboard) to the wall, using two screws at every stud location (see mounting detail below). This hanger strip serves two purposes: It's a sturdy anchor, and it adds depth for building out the rack enough to make a good ledge on which to hang the bar clamps. Along the bottom of the hanger strip goes another ¾-in. plywood cleat (what some people call a French cleat) with a 45° cut along the top edge. That bottom cleat gets screwed to the hanger cleat. Another plywood cleat with a 45° cut along the bottom edge has blocks of lumber screwed into the front face from behind. The blocks on this cleat are spaced apart so there's room to hang the clamps on them.

Nothing fancy—most of the racks I used were salvaged from my previous shop, where they've given 20 years of faithful service so far. Depending on the type of clamps, they will hang better facing in or out, because of how the weight is balanced. On the 12-ft. wall shown on the facing page, I store 108 clamps, and there's room for more.

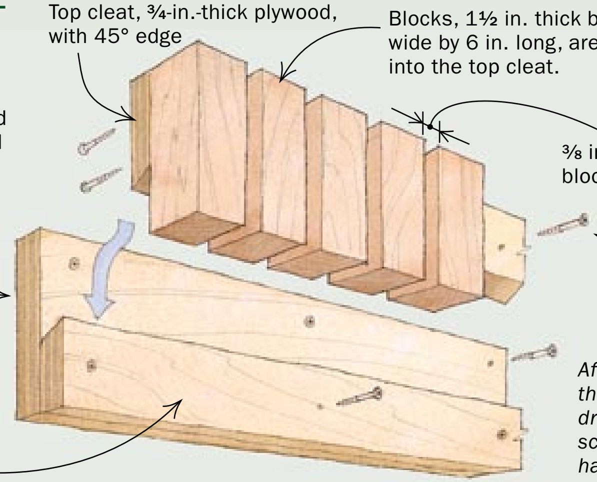
John West owns and operates Cope and Mould Millwork in Ridgefield, Conn.



PLENTY OF BAR CLAMPS

By hanging all of his clamps on one wall, West can space the hanging racks apart as necessary to fit different sizes of clamps. The deep-throat bar clamps face outward; the more traditional, older-style bar clamps face the wall.

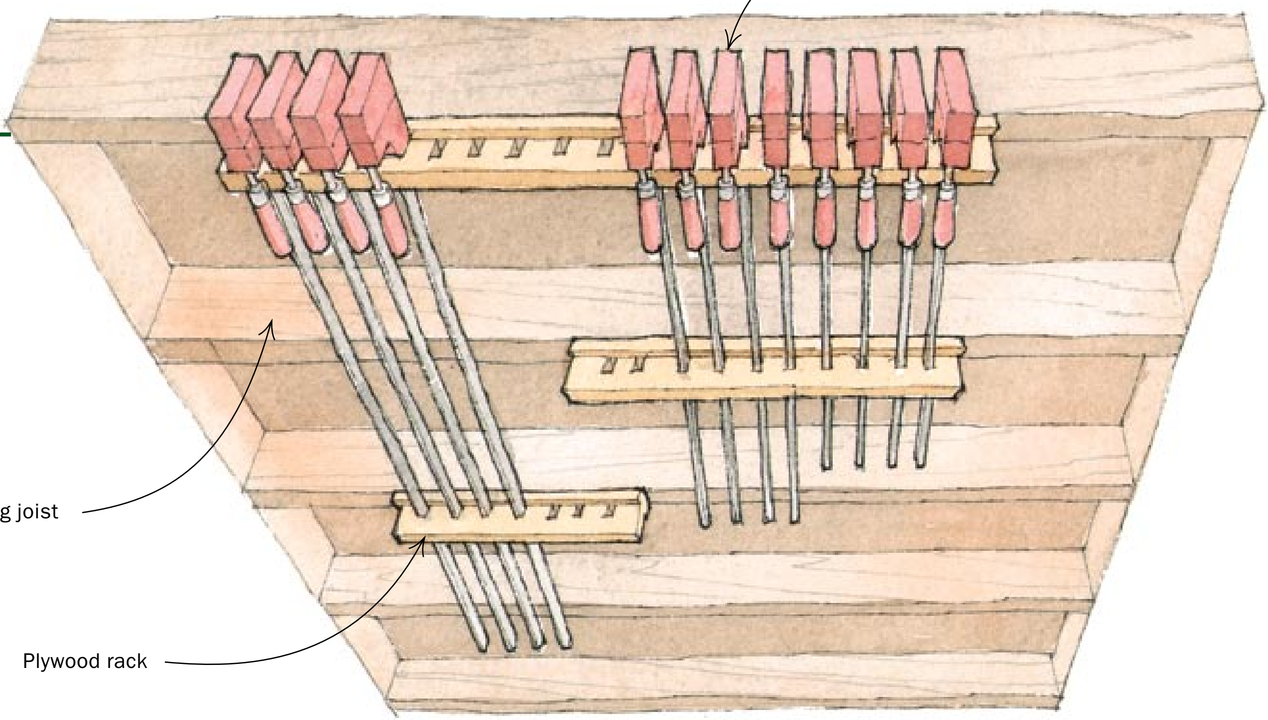
MOUNTING DETAIL



Ceiling and Wall Racks

BY BROOK DUERR

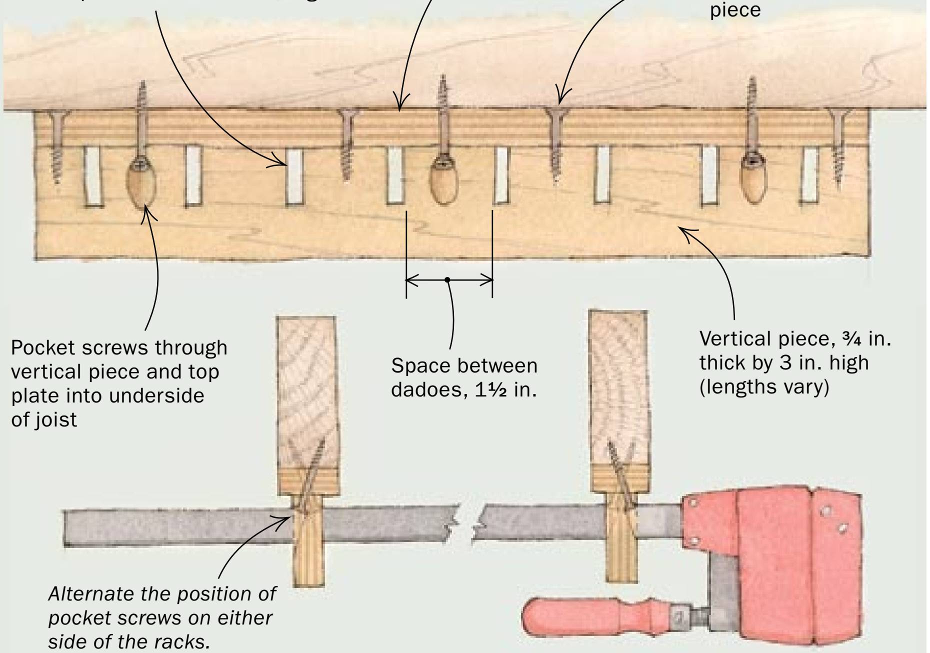
In a shop lacking storage space, look for ceilings and wall alcoves to fill the need



BAR-CLAMP CEILING RACK

To hold bar clamps, Duerr fastened plywood racks directly to the underside of the ceiling joists. He staggered the position of the racks to accommodate various lengths of bar clamps.

MOUNTING DETAIL



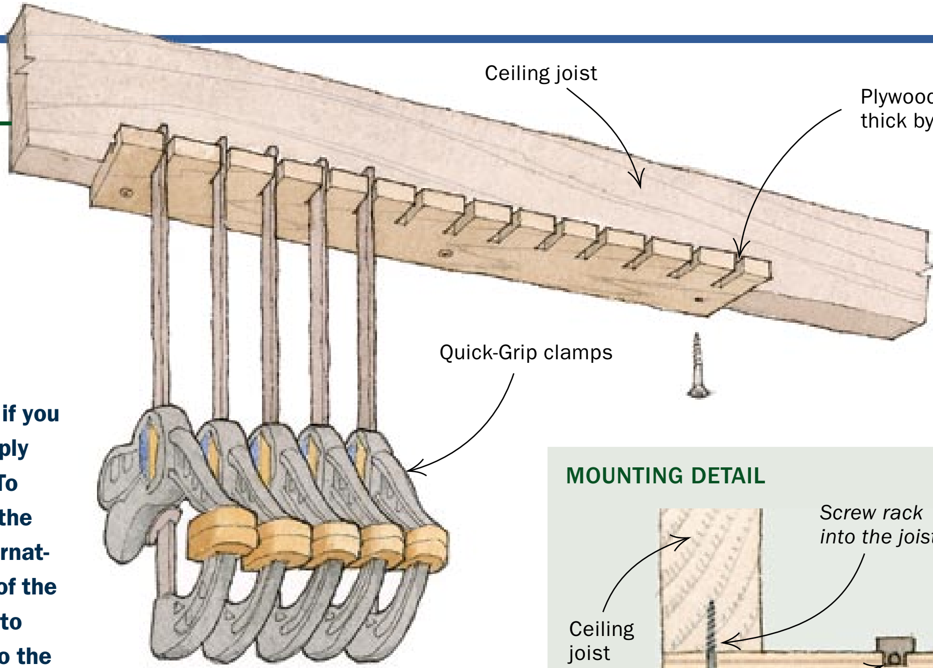
In my basement shop, wall and floor space are scarce. Faced with a growing collection of all kinds of clamps, I didn't know where to store them. One day it dawned on me that I could make use of the unfinished ceiling, with its exposed joists, and one wall alcove to store clamps out of the way. I designed and built several different racks, basing the design on the dimensions of each type of clamp.

For my bar clamps, I constructed each rack with two strips of ¾-in.-thick Baltic-birch plywood, fastened together into a T shape with screws driven through the top plate. The top plate is 1½ in. wide, and the vertical piece is 3 in. wide; the lengths will vary according to the number of clamps of each size you need to store. Before assembling the two pieces, I used a dado blade to cut a series of ½-in. by 1½-in. dadoes to serve as slots for slipping the clamps into the racks. You could

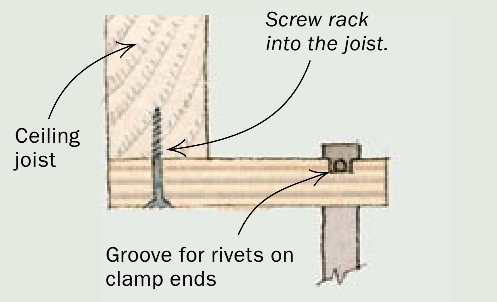
Drawings: Jim Richey; photo, facing page: Barbara Duerr

QUICK-CLAMP CEILING RACK

This ceiling rack is custom-made to hold Quick-Grip clamps. A groove in the top of the rack stabilizes the hanging clamps and keeps them from falling out.



MOUNTING DETAIL



use a finger-joint jig on the tablesaw if you have a lot of dadoes to cut, but I simply marked each one with a pencil line. To fasten the racks to the underside of the joists, I used a pocket-screw jig, alternating every other screw from one side of the rack to the other. I put the clamps into the closed position and slip them into the racks with the bottom end first.

For my Quick-Grip clamps, I made a plywood rack, ¾ in. thick by 5 in. wide, that's screwed into a joist from below. I cut a series of dadoes on one side only for hanging each clamp. I also used the dado blade to cut a groove in the top surface that runs the length of that edge. The rivets on the bottoms of the clamps sit in that groove and keep the clamps from falling out.

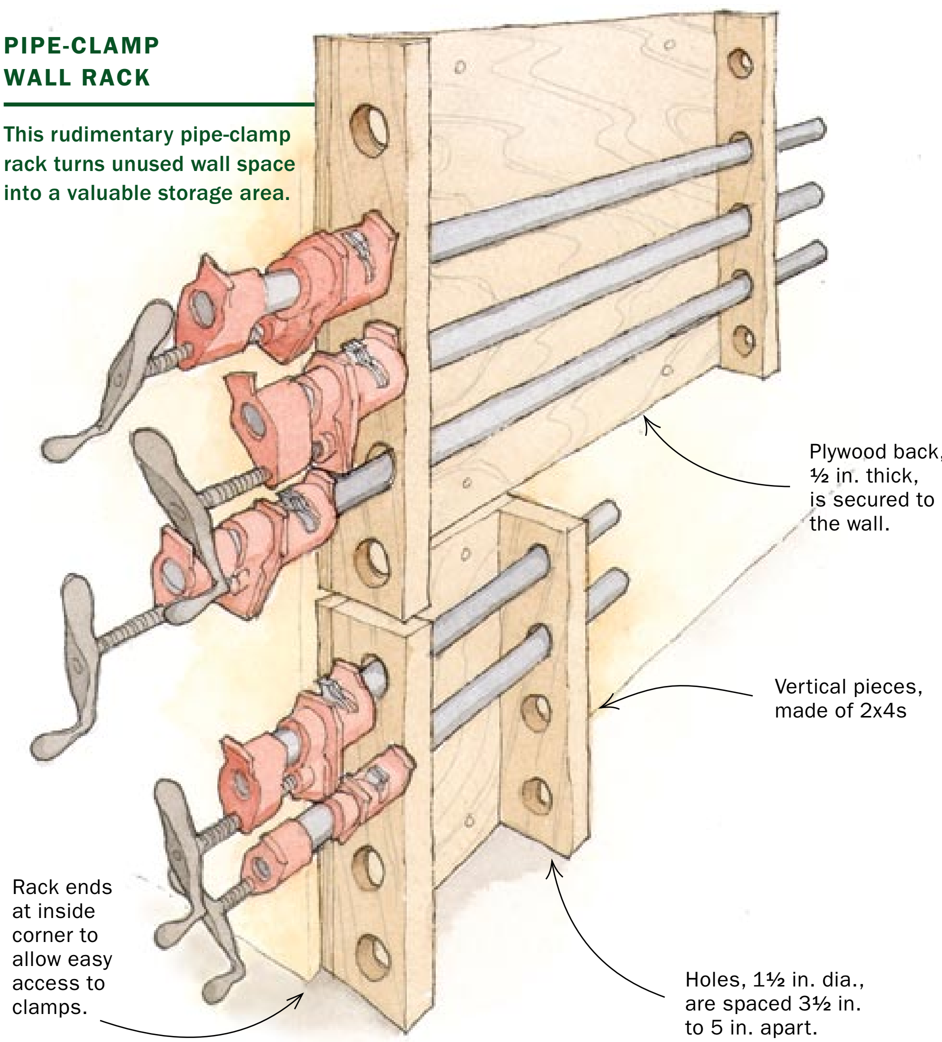


To store my pipe clamps, I drilled a series of 1½-in.-dia. holes in matching pairs of 2x4s and mounted them onto a ½-in.-thick plywood back. I screwed the assembly to studs against the wall where I store my dust collector. I drilled the holes 3½ in. apart, but if I had to do it again, I'd make the spacing about 5 in. apart to provide more clearance for the clamp heads. With this design, it's important that one end is on the outside corner of the wall so that the clamp handles don't bind against the wall as you place the pipe clamps into the rack; then you'll have easy access to them when you need them.

Brook Duerr, a research scientist for a medical-device manufacturer, lives near St. Paul, Minn.

PIPE-CLAMP WALL RACK

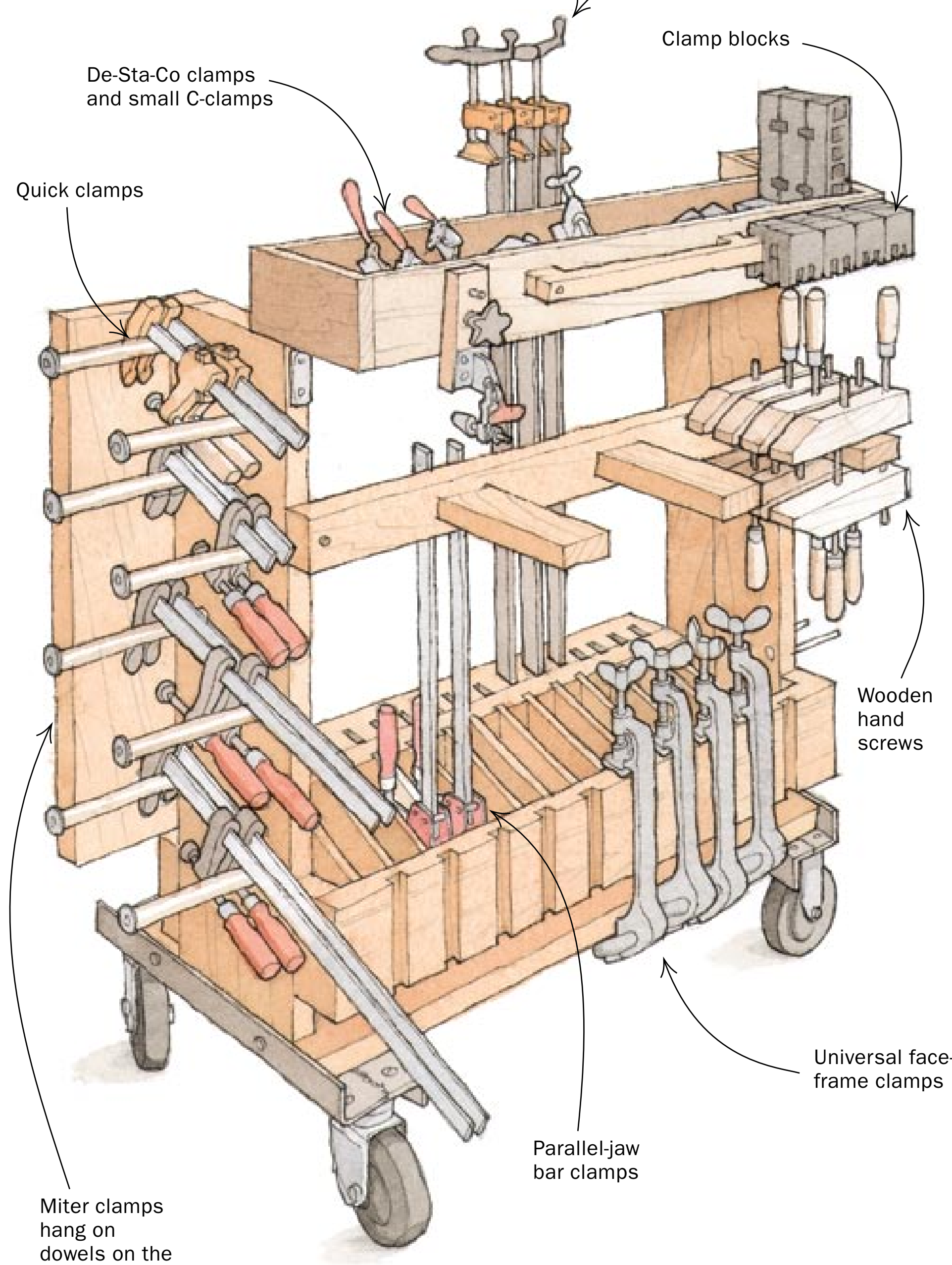
This rudimentary pipe-clamp rack turns unused wall space into a valuable storage area.



Clamp Cart

BY DAVID DiRANNA

When floor space is plentiful, rolling storage racks bring the clamps where you need them



I took up woodworking more than 25 years ago when I received a radial-arm saw as a present. For most of that time, I had to share shop space with two cars in a three-car garage. But a few years ago, I kicked out the cars, reorganized the layout of the shop, and built storage cabinets along many of the walls.

The layout gave me a lot more floor space, so I decided to store my small clamp collection in a mobile cart. I put most of the machinery on casters for the same reason—I like being free to move things around. On one end, two casters are fixed, while the other two are swivel; that combination works best.

My main problem with clamps is that I keep buying more. When I started building this clamp-storage cart, I didn't have a master design for it as it now looks, because I had many fewer clamps than I do now. The design of the cart has undergone a sort of organic evolutionary process over time.

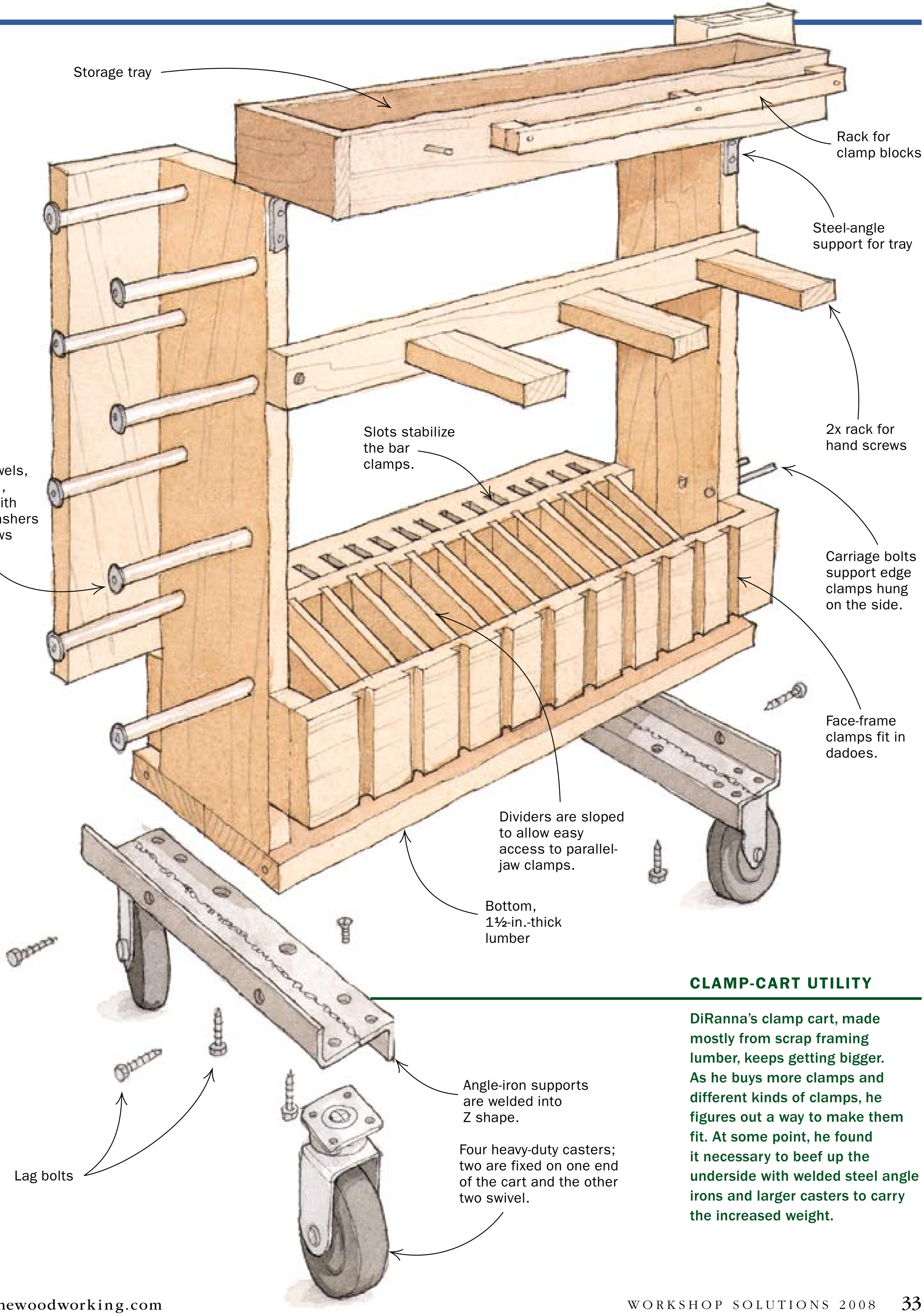
The purchase of every new batch of clamps has turned this into a modular construction project. I just keep finding ways to add onto the cart to accommodate my most recent purchases. The cart got so heavy at one point that I found it necessary to replace the original 3-in. casters with a heavier-duty 5-in. ball-bearing style. I figured out recently that I'm storing more than $2,000 worth of clamps on the cart. I just hope I don't get the urge to buy any more.

David DiRanna taught college-level business courses for many years before switching careers to a business-management position.



Have clamps, will travel. *Blessed with plenty of floor space, DiRanna chose to put all of his many clamps on a rolling cart.*

Photo, this page: Dean Della Ventura



CLAMP-CART UTILITY

DiRanna's clamp cart, made mostly from scrap framing lumber, keeps getting bigger. As he buys more clamps and different kinds of clamps, he figures out a way to make them fit. At some point, he found it necessary to beef up the underside with welded steel angle irons and larger casters to carry the increased weight.

Quick-to-Make Tool Cabinet

Build a simple case, and then add custom holders

BY JAN ZOLTOWSKI

After a career of 35 years, I had collected a substantial number of woodworking tools and I finally decided that they deserved a proper home. I set out to create a cabinet capable of holding my tools in a relatively small but accessible area. The result is home to well over 300 tools, yet covers only about 12 sq. ft. of wall.

I deliberately dedicated this cabinet to hand tools to keep them apart from dusty power tools, but the design can be modified easily to accommodate small power tools as well. Think twice before making the cabinet smaller; even if your tool collection would look lost in a cabinet of this size, it's nice to have space to grow into.

No wasted space

The inside surfaces of the main doors hold thin tools such as chisels and screwdrivers. Inside the cabinet, working down from the top, the upper shelf seats larger handplanes; the middle section has a pair of internal doors that support tools on both sides (increasing the hanging area by 40%) and that open to reveal additional space for saws and marking tools. The lower area is divided into cubbyholes for smoothing planes and other specialty planes, while six small drawers in the bottom hold smaller tools such as block planes, drill bits, and router bits.

The cabinet hangs on upper and lower pairs of French cleats. Behind the cabinet, in the space between the cleats, is a

A brief tour



***Drawers for small objects.** The six drawers at the bottom of the cabinet hold small tools such as block planes, as well as drill and router bits.*



***Hinged panels add storage.** Tools hang on both sides, increasing the cabinet's hanging area.*



***Storage behind the cabinet.** A carpenter's square on one side and three panel saws on the other fit into slots in the back of the cabinet.*

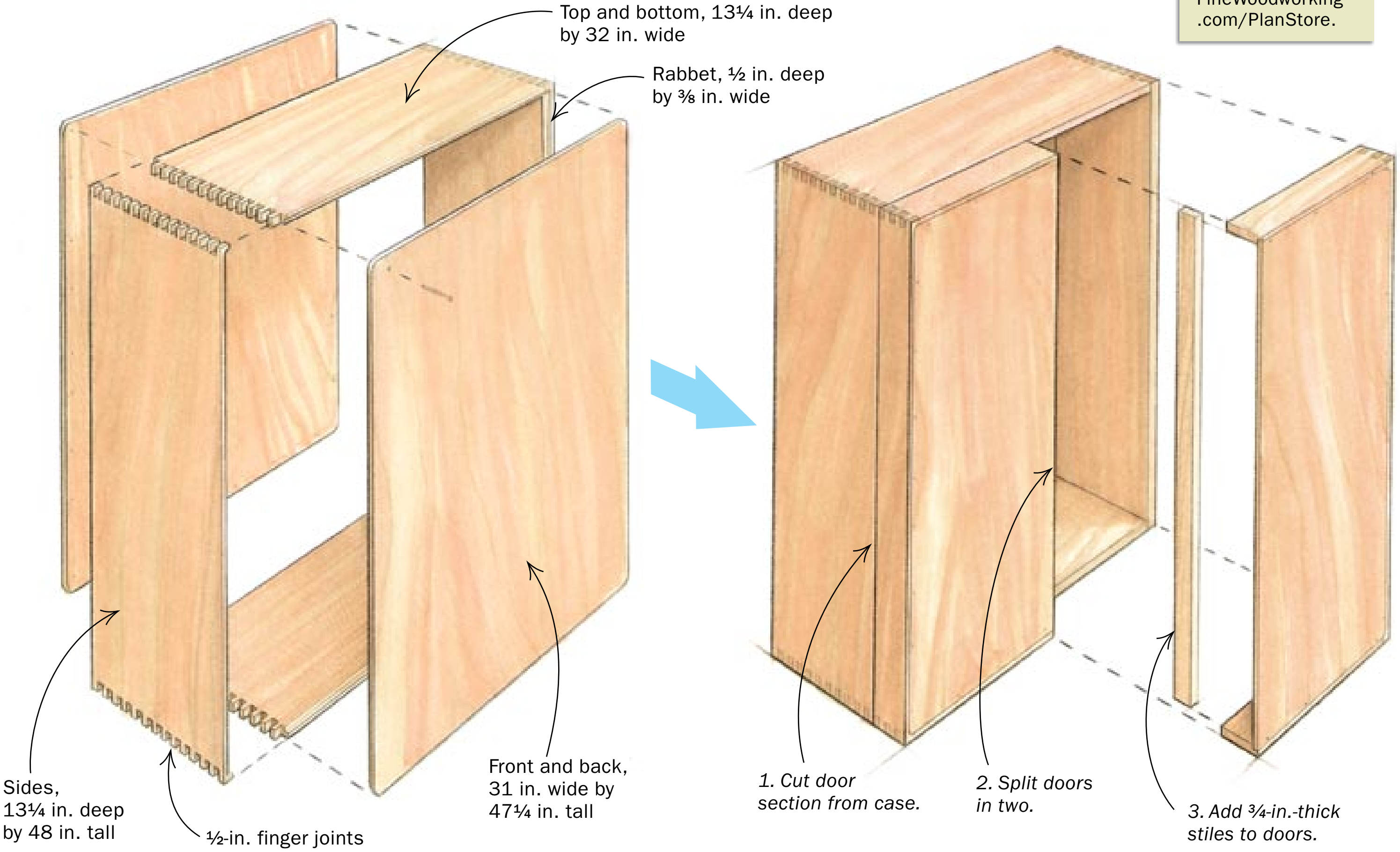
Photos: Mark Schofield


DREMEL
DREMEL

A COMPACT CABINET WITH AMPLE CAPACITY

The cabinet is made almost entirely from birch plywood, which gives dimensional stability at a budget price. The main carcase is ¾-in.-thick plywood connected with finger joints.

Full-size plans for this cabinet and other projects are available at FineWoodworking.com/PlanStore.



Construct the carcase





Build a big box. *The main body of the cabinet is connected at each corner with ½-in. finger joints cut on the tablesaw (left). Rabbet the front and rear for the panels. Glue and nail the front panel (above), but attach the rear with screws for interior access.*

Drawings: Bob La Pointe

place to hold a carpenter's square on one side, and three panel saws, held securely by means of the friction of their teeth, on the other. The cabinet holds all these tools within easy reach, and every blade and tooth stays sharp and protected.

Construction starts with a single box

I built my cabinet out of Baltic-birch plywood. Not only is it more economical than solid lumber, but it also eliminates problems such as stuck drawers from dimensional changes caused by high humidity. The body of the cabinet starts out as one large box with the sides made from ¾-in.-thick plywood. Join the corners with ½-in. finger or box joints (for a quick primer on box joints, see p. 78).

Rout a ½-in.-deep by ⅜-in.-wide rabbet around the inside front and back edges to accept panels of ½-in.-thick plywood. The cabinet front is attached with glue and nails, but the back is screwed on to allow access during later construction.

Next, cut off approximately the front third of the box to form what will become the main doors. On the tablesaw, using the rip fence as a guide, cut through both ends of the box. Attach a thin piece of scrap plywood to each end by nailing it on both sides of the cut. This is to keep the two parts of the box attached while cutting through the long sides on the tablesaw.

While at the saw, cut the newly removed front section of the cabinet in half to form the two main doors. When this is done, attach pieces of ¾-in.-thick plywood to form one stile of each door. Don't worry about the exposed edges of the plywood sides; these will be covered by banding.

Create the gallery and drawers

The central gallery, with its cubbyholes used to store planes, gives the cabinet rigidity. Cut the upper and lower shelves, then cut the dadoes for the ¼-in.-thick dividers either on the tablesaw or with a router. Use the same method to create the dado on the underside of the gallery to receive the center drawer divider.

Before installing the gallery you need to make the drawers, because their height and spacing will determine the location of the gallery. The six drawers are made of ½-in.-thick plywood with ¼-in. finger joints. The bottoms, made of ¼-in.-thick plywood, sit in a rabbet rather than a groove because the latter would reduce the depth of these already-shallow drawers.

After unscrewing the back panel of the cabinet, rout a dado on each side for the top shelf, and then glue in the shelf. Stack the drawers using laminate or thin cardboard as spacers, and mark the top of the stack for the dado location for the bottom shelf of the gallery. Lay the gallery across the cabinet and mark the dadoes for the top shelf. Cut the pair of dadoes on each side, and then install the gallery and the central drawer divider. The latter is screwed to the bottom of the cabinet from the outside and is not dadoed, so as not to weaken the bottom of the cabinet.

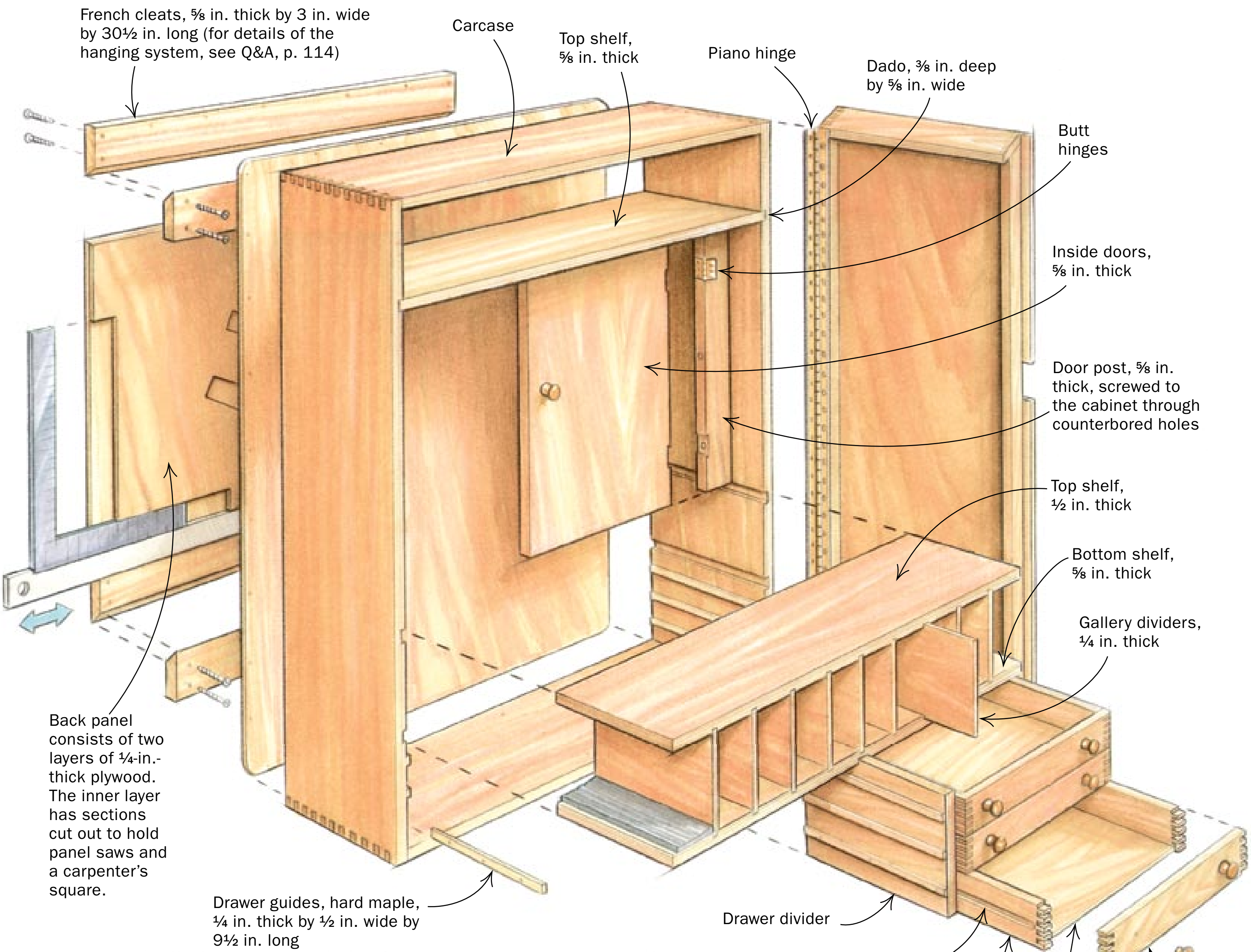
I hung the drawers by attaching ¼-in.-thick by ½-in.-wide strips of hard maple to the sides of the cabinet and the central divider. To get the drawers to hang perfectly

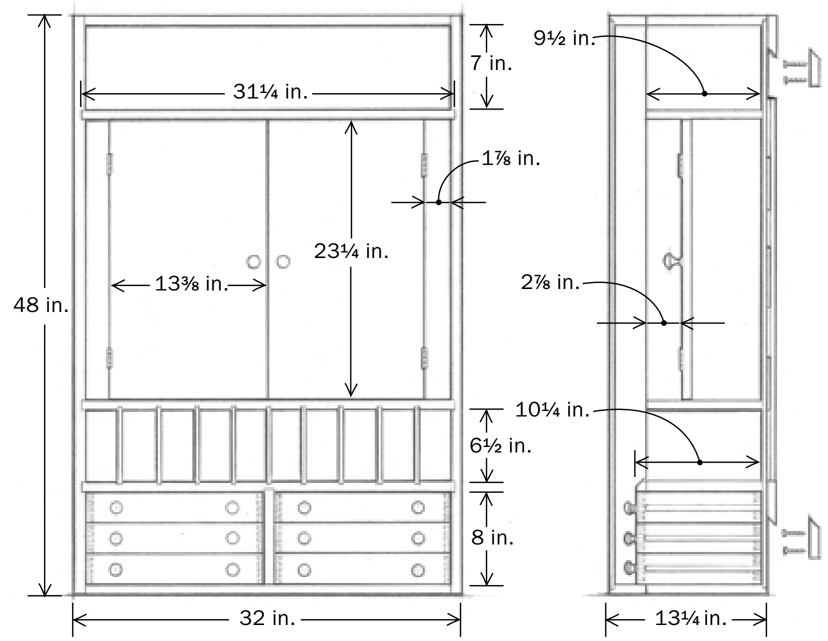


Cut away the door section. *With the front and rear panels installed, cut away the front quarter of the box to form the main doors. Cut the short sides first, and then tack a batten across the cut to hold the section in place while cutting the long sides.*



Next cut makes the two main doors. *Tack two strips of wood across the cut line as shown. Then set the sawblade to just score the underside of the strips. In this way the panel is cut in half but won't bind on the sawblade.*





SHELVES AND CUBBYHOLES PROVIDE TOOL STORAGE

The internal doors are ⅝ in. thick; the shelves are either ⅝ in. or ½ in. thick, and the front and back are ½-in.-thick panels. The drawers are made from ½-in.-thick material with ¼-in.-thick plywood used for the drawer bottoms and the gallery dividers.

parallel, I used the same spacers when cutting rabbets in the drawer sides and when attaching the strips to the cabinet.

On a router table, create a guide channel the same width as the drawer sides comprising two outer guide strips, two center strips of wood the width of the straight-cut router bit, and two equal spacers to go above and below the bit that center the drawer side over the router bit. Clamp the outer strips to the table, remove the spacers and the center strips, raise the bit to ¼ in., and cut a groove until just before the finger joints at the front of the drawer.

When all the grooves have been cut, use the spacer strips from the router table and the laminate spacers used earlier when stacking the drawers to establish the location for each maple drawer runner. Screw the runners to the sides, and the central divider and the drawers are hung.

The two inner doors and their posts are made from ⅝-in.-thick plywood. Cut matching recesses on each door and post for a pair of hinges, and then screw each post to the sides of the cabinet between the top of the gallery and the upper shelf. Hang the doors on these posts.

The separate unit at the back of the cabinet is built of two layers of ¼-in.-thick plywood and should be designed to accommodate carpenter's squares and panel saws. Screw this unit to the back of the cabinet between the French cleats.

The outer doors are hung using piano hinges and magnetic catches; ball catches give a positive latch to the doors. After hanging the front doors, conceal the exposed rabbet joint around the front panel with a 3⁄16-in.-thick by ¾-in.-wide strip of solid maple, rounded slightly (as all exposed corners should be).

With the main cabinet construction complete, make and attach custom hangers for each tool using scraps of plywood.

I finished my cabinet with two coats of oil-based sealer that were sanded with P320-grit sandpaper. Then I wiped on a couple of coats of tung oil.

The cubbyholes and the bottoms of the drawers were covered with industrial rubber-backed floor covering, available from home centers. It comes in many colors and gives excellent protection to edge tools. The final step was to attach pulls to the drawers and doors, and stout handles to the outside of the cabinet. These are a great help when you and a friend lift the cabinet onto the wall-mounted part of the cleats. □

Jan Zoltowski is a professional antique and art restorer who lives near Seattle, Wash.

Assemble the interior



Install the upper shelf and gallery. *Cut a dado on both sides of the cabinet and install the upper shelf. This gives the carcase extra rigidity. After routing the dadoes for the upper and lower shelves, test-fit the gallery and then glue it in.*



Attach the inner doors. ***Stretching from the top of the gallery to the bottom of the top shelf, each inner door is hung from a post screwed to the cabinet.***



Storage behind the cabinet. *An inner layer of ¼-in.-thick plywood is cut to receive panel saws and a carpenter's square, then covered by a solid outer piece of plywood.*

Custom holders for hand tools

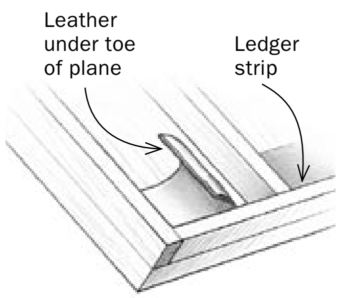
BY CHRISTIAN BECKSVOORT

A tool cabinet is only as useful as its layout, and Chris Becksvoort makes the most of the space in his by storing hand tools in custom-made holders. Handplanes are kept on an angled tray, with cubbies for individual planes, and there's storage space behind the tray. The rest of his tools—chisels, layout tools, etc.—are stored in his cabinet on hangers specifically sized and designed for each type of tool. Here's a look at Becksvoort's approach to storing hand tools.

HANDPLANES



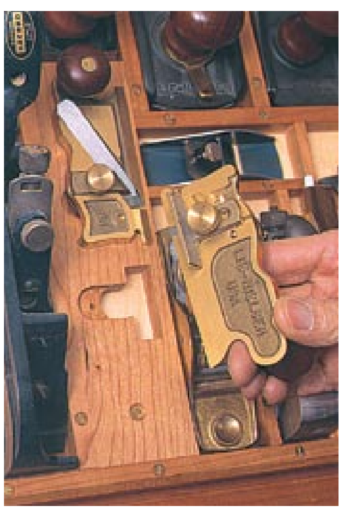
Planes within easy reach. *Ledger strips strategically located on the tray create custom-sized holding areas for Becksvoort's handplanes. To protect the blade of each plane, he glues a small piece of leather under the toe (below).*



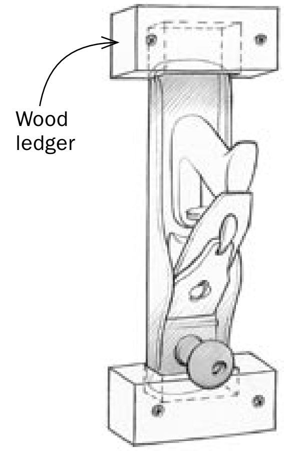
Planes take up a fair amount of space, no matter how you store them. But you have several options to make them accessible.

Believe it or not, many woodworkers like to hang planes vertically. A wooden plane can be fitted with a screw eye in the end and hung from a hook. A metal plane can be fitted between two cleats; both cleats are mortised to hold the plane. To remove, slide the plane upward (leave room in the top mortise for clearance) until the nose comes out of the bottom cleat, and pull the plane forward and down to clear the bottom and then the top cleat. Or you may opt for a fitted cleat on the bottom only and a high-power rare-earth magnet near the top. Of course, this won't work for wooden or bronze planes.

To save space you also can store planes on fitted shelves with dividers, as Zoltowski does. I chose to store my planes on an angled tray (see photo, top left) with small (½-in. by ⅝-in.) ledger strips between them. The tray is angled at 60° so that a strip in front of each plane is all that's needed to keep the tool in place. The tray is hinged at the top and has three shelves inside. I don't like to waste space, so I store seldom-used items in there: spare parts, blades, and fences. The tray needs to be emptied to gain access, because the 17 planes stored on it probably weigh close to 40 lb.



A home for every tool. *Odd-shaped tools, such as a side rabbet plane, fit into french cutouts in the tray.*



STORE PLANES VERTICALLY
Extra room in the top cleat's mortise allows you to lift up and remove the plane easily. The bottom cleat bears the weight of the plane.

LAYOUT TOOLS

Layout and measuring tools are an odd bunch, because there are so many different individual shapes. A framing square can be hung by the short leg either on a 16-in.-long strip with a groove for the edge or on two small ledger blocks—one at the end and the other right at the inner corner. The ledger strips should have small lips.

Squares slide into sawkerfs cut on a small shelf. *This method takes up much less space than laying them out flat.*

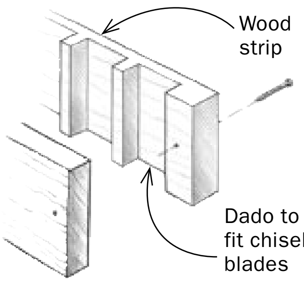




CHISELS

Chisel storage devices are easy and relatively quick to build. Chisels are all the same shape but different in width and thickness. Sets can be stored together, graduated from the shortest to the tallest. Here are three commonly used alternatives.

My favorite method for chisel holding is a wood strip dadoed to accept chisels of various widths (see drawing, below). Vary the spacing between narrow chisels to allow clearance for the handles. As the chisel blades become wider than the handles, the spaces get narrower. All chisel slots are a bit wider than the blades. A 1½-in. to 2-in. strip is all that's required to hold the chisels upright. That requires only 2 in. to 2½ in. of clearance over the tops of the chisels to pull them out.

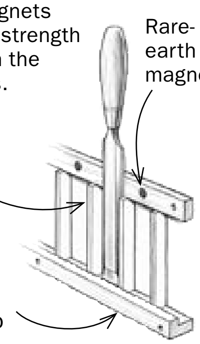


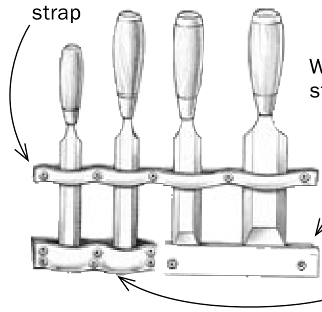
Another option is to use a rabbeted wood shelf at the bottom to support and protect the blades (right). Vertical divider strips determine the spacing of the chisels. High-power rare-earth magnets hold the chisels upright and in place. The magnets will have to be drilled into a horizontal strip to allow clearance for the chisel handle against the panel.

In my previous toolbox I used leather straps to hold the chisels (right). They can be used above and below or with leather on top and a wood strip below.

TWO ALTERNATIVES

Rare-earth magnets offer plenty of strength to secure even the largest chisels.





Leather straps will hold chisels in place, but a wood strip might last longer against the sharp edges.

Long rulers and straightedges are most easily hung from a round-head screw through a hole in the end. Remember to hang the ruler at least ⅜ in. proud of the surface or carve finger-relief holes to make grabbing the ruler easier. The same method can be used for story sticks, trammel heads on a beam, and winding sticks.

Small squares can be stored in a variety of ways. The best-looking but most time-consuming method for any tool is the french cutout, in which a tool sits in a custom-made cutout. Much faster and easier is to let the head of the square rest on a ledger strip (see photo, p. 35). The method I prefer, especially with an assortment of squares, is to mount them on a 6-in.-deep shelf with slots in the front to accept the blades of each square (see photo, left).

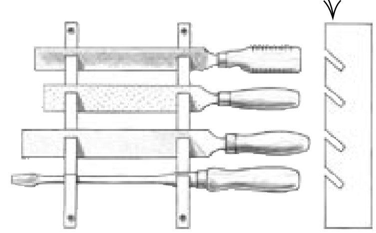
SCREWDRIVERS, FILES, AND AWLS



Screwdrivers, files, and awls can be stored easily. After all, they are nothing more than metal rods or bars stuck into wood handles.

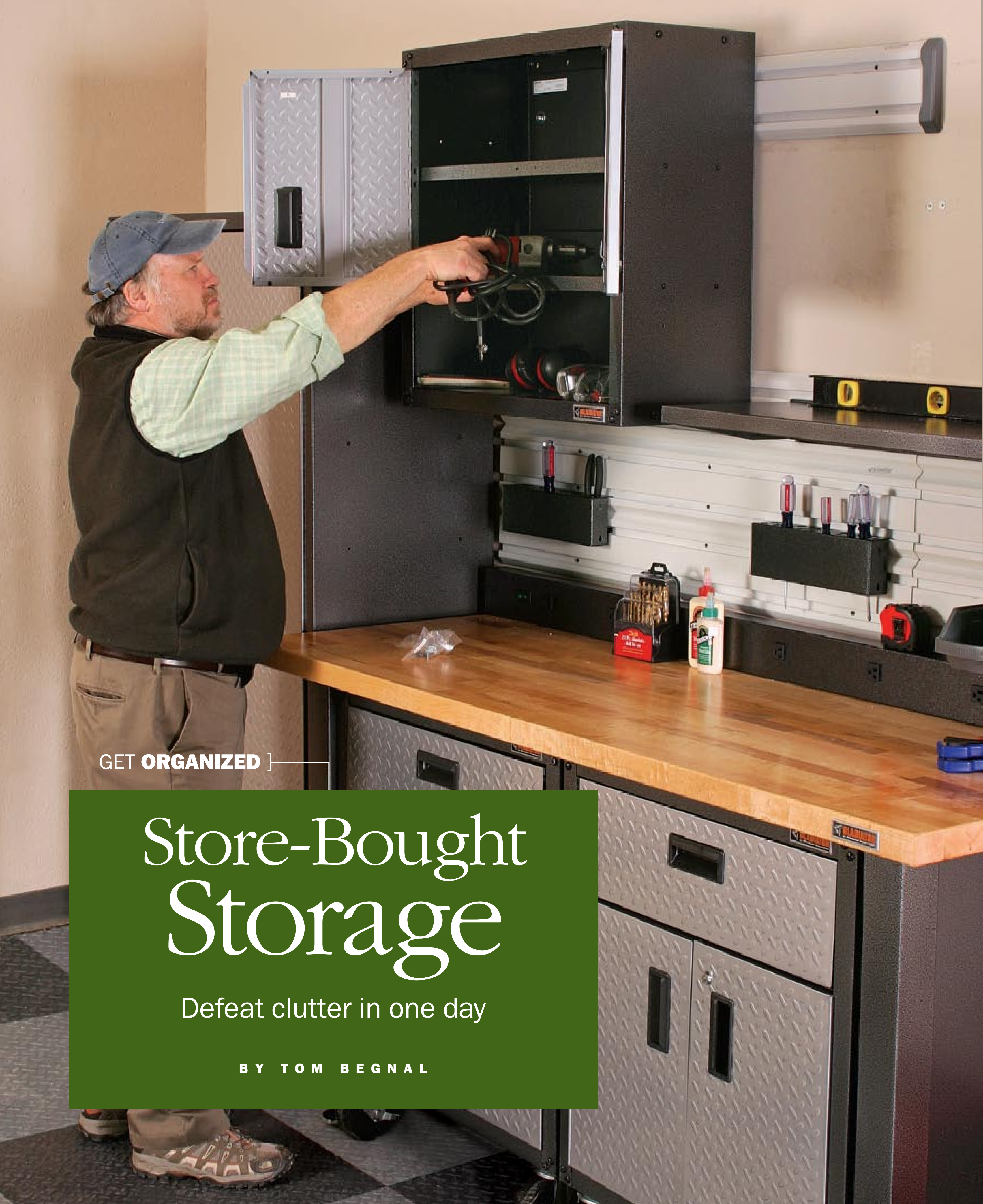
My favorite method is to hang these tools. A ¾-in. by 2-in. strip of the correct length will suffice. Measure the ferrules or the base diameters of the tools, space them as needed, and drill slightly oversize holes partway into the strip. Then locate the hole centers and saw a slot to the back of the hole. This yields a small shoulder on both sides of the cut, which supports the ferrule. The slot allows for easy removal. Simply lift the tool a mere ½ in.

Files and screwdrivers with large flats on the upper shaft can be stored horizontally on racks or trees consisting of two parallel uprights with 45° slots cut into them (below). Trees are merely uprights with holes drilled through the sides.



A few passes over the tablesaw will make a quick horizontal storage rack.

Photos: Michael Pekovich; drawings: Michael Gellatly



GET **ORGANIZED**

Store-Bought Storage

Defeat clutter in one day

BY TOM BEGNAL

An old woodworking maxim tells us that we never have enough clamps. Well, I'd like to suggest another truism: Woodworkers never have enough storage space.

Storage space is important because it helps get the shop organized. When we're organized, we find things faster and work more efficiently. When we work more efficiently, our time in the shop is more productive and more enjoyable. And, of course, enjoyment is what it's all about.

When it comes to adding shop storage, woodworkers have two main options: buy it or make it. Now, many woodworkers will wince at the thought of buying something that they can easily make. After all, they have all the tools and skills to do the job.

But store-bought storage has several pluses. For one thing, in today's marketplace, you have lots of storage options, from simple shelves to sturdy cabinets. You can buy many of these products in the morning and put them up in the afternoon. Also, they often cost less to buy than to build. We did a comprehensive search for all manner of manufactured storage ideas, and found some options that make a lot of sense for the home shop.

Longevity trumps appearance

These storage units are going into a workshop, so appearance shouldn't be a big consideration. A flat-panel melamine door might not look as good as a raised panel in birch, but it will cost less and work as well for just as long.

Above all, you want the shelves and cabinets in your shop to be sturdy. Some of the really low-cost shelving systems can be pretty rickety, although you usually can solve that problem by mounting a plywood gusset at each corner or securing the unit to a wall.

Look for storage that fits your tools and materials and how you use them. Also, you'll want drawers that slide easily and smoothly. Full-extension slides are a plus, as they extend the entire drawer out of the cabinet. That makes it easier to access anything in the back of the drawer. If you plan to put heavy tools in the drawer, make sure the slides can handle the weight without sagging when the drawer is opened.

Lots of options and sources

When shopping for storage systems, there's no shortage of places to look. The big-box home centers, such as The Home Depot (www.homedepot.com) or Lowe's (www.lowes.com), are good places to start. Jumbo department stores like Sears (www.craftsman.com) also carry storage units. Stores like Ikea (www.ikea.com) that specialize in home furnishings have storage that adapts well to the shop. Then, too, if you do an online search of "garage storage," you'll find several mail-order stores dedicated to these types of units.

All these outfits carry an assortment of storage units. Materials range from melamine to plastic to steel, or some combination of the three.

Some units are as simple as a shelf system. Others are storage cabinets with various mixes of doors, drawers, or shelves. And still others are inexpensive kitchen-cabinet units recruited for workshop duty. All



Shelving units

For storage on a budget, or where you want easy access, a simple shelving system is hard to beat. This one, made from steel, attaches to wall studs, creating solid support for almost anything.

IKEA SHELVING UNIT
www.ikea.com
MODEL: Broder
PRICE: (as configured) $335



It's easy to adjust the Ikea shelves up or down. *Just reposition the horizontal support brackets in the posts (above).*

Kitchen cabinets

Cabinets designed for the kitchen can be put to good use in a workshop. No need for fancy hardwood here. Just look for a basic melamine cabinet with adequate sturdiness to withstand shop abuse.

IKEA KITCHEN CABINETS
www.ikea.com
MODELS:
BASE AND WALL CABINETS: Akurum
DRAWERS: Rationell
DOOR AND DRAWER FRONTS: Sorbo
COUNTERTOP/WORK SURFACE: Pronomen (1⅛-in.-thick beech)
PRICE: (as configured) $650

ROLL-AROUND CART: Alex
PRICE: $120



A place for everything. *Wire basket drawers are lightweight and provide easy access to power tools or small boxes of hardware.*



Have it your way. *One of Ikea's cabinetry clerks configured this system for us on a computer, which generated a parts list. The white rolling cabinet fits between the base cabinets under the bench.*

require some assembly, although most of it can be done with little more than a hammer and screwdriver. Quality and sturdiness run the gamut from fair to pretty good.

Shelving units—Shelf systems come in a variety of sizes, materials, and prices. They tend to be cheaper and easier to assemble than other storage units. I prefer steel units, mainly for strength.

On the downside, because shelves store everything in the open, they are not the most aesthetically pleasing option. Exposed storage like this can make a shop look cluttered.

Kitchen cabinets—There's no law that says kitchen cabinets must be used only in the kitchen. In fact, they adapt quite well to workshops. And you don't need to spend a lot of money. A low-end—but more than sturdy enough—18-in.-wide base cabinet made from melamine with three drawers costs about $100. A similar wall unit (with a door rather than drawers) measuring 18 in. wide by 30 in. tall sells for around $175. You can reduce those prices if you buy versions that require assembly.

Kitchen base cabinets can be transformed into a sturdy work surface without much fuss. Just put two units side by side and add a top made from plywood or (better yet) butcher block. Anchor the cabinets to the shop wall and add a woodworker's vise, and they instantly become a rock-solid workbench.

Dedicated shop storage—Several storage systems are designed specifically for garages or workshops. Typical systems include tall and short base cabinets, wall cabinets, and workbenches. Some even include color-matched flooring. Depending on the brand or model, assembly can vary. For the most part, steel is the material of choice. Some units come with casters, making them easy to roll around.

Gladiator has the best bench

Anyone in need of shop storage would welcome any of these systems. All had enough strength and stiffness to hold a good many woodworking tools.

I particularly liked the extra sturdiness of the Gladiator workbench. I also appreciated the flexibility it offered when used with the GearTrack Channel. On the downside, expect to pay extra for the system.

Tom Begnal is an associate editor at Fine Woodworking.

Photos: Staff

Storage systems

Cabinet systems designed specifically for the garage or workshop offer lots of storage options. These versatile systems often incorporate handy work surfaces.

SEARS CRAFTSMAN GARAGE STORAGE
www.sears.com
PRICE: (as configured) $1,200





Multipurpose storage. *The five-drawer rolling cabinet makes a fine tool stand (right) and fits comfortably under the workbench unit (above).*



GLADIATOR GARAGEWORKS
www.gladiatorgw.com
PRICE: (as configured) about $1,000



Storage system that works. *The Gladiator system features a number of options that make it more functional, such as a fold-down work surface on a wall shelf (above). The GearTrack Channel simplifies the hanging of wall cabinets and also accepts a wide assortment of Gladiator hooks, holders, bins, and baskets.*



Rolling Carts Made to Last

Choose the right casters and build sturdy bases

BY JOHN WHITE

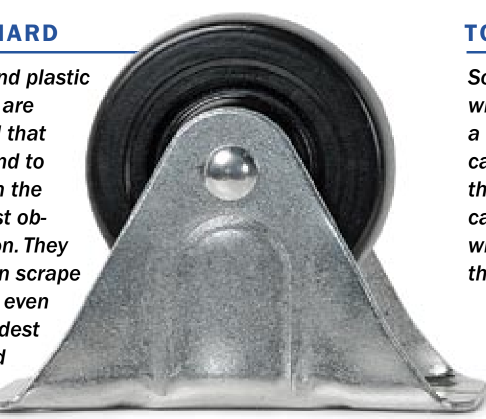
Small shop or large, it makes sense to put some machines and fixtures on wheels. Whether it carries a benchtop planer, a worktable, or a wood rack, a rolling workstation not only frees up space but it also helps you line up your tools—and your materials—more efficiently for specific jobs.

However, these little wheels can also cause big problems. They can leave a power tool restless, fidgeting when you want it to stand still. Poorly designed or poorly loaded, they can make their cargo tippy. They can stop on a dime—or a sliver of wood—while you're gliding from A to B; and they can wreak havoc on your shop's new hardwood floor.

So how do you get the most out of a set of casters? Simple. Choose the right ones for the job at hand, and mount them properly on the base of the tool or fixture they support. Casters come in a wide variety of sizes and styles, but for most workshop applications you

WHAT TYPE OF WHEEL?

TOO HARD



Steel and plastic wheels are so hard that they tend to snag on the slightest obstruction. They also can scrape or dent even the hardest of wood floors.

TOO SOFT



Soft rubber wheels have a low load capacity, and their "give" can make what's riding on them a bit tippy.

JUST RIGHT



Urethane wheels are soft enough to climb over small obstructions, yet hard enough to keep the load stable.

Photos: Staff; drawings: Vince Babak

WHAT SIZE?

Use this chart to decide how big the casters should be for your specific job.

LOAD WEIGHT	TYPICAL USE	Smooth floor		Rough floor	
		WHEEL DIAMETER	RATING	WHEEL DIAMETER	RATING
Less than 200 lb.	Thickness planer, drill press, miter saw, sanding station, furniture dolly	4–5 in.	75 lb.	5 in.	75 lb.
200–400 lb.	Large cabinet, tool cart, small clamp rack, assembly table	5 in.	150 lb.	5–6 in.	150 lb.
More than 400 lb.	Large clamp rack, sheet-goods rack	5–6 in.	250 lb.	6 in.	250 lb.



need only consider those most commonly offered in woodworking catalogs (see Sources of Supply, p. 51). Here's what you should know.

Key factors: rolling, steering, stopping

You'll find casters with a range of tire materials, from soft rubber to rock-hard steel or plastic wheels. My advice is to stick with Mr. In-Between: urethane. It's the same material used for skateboard wheels. Tires made of this synthetic material have enough "give" to climb over wood chips; they have a good load capacity for their size and cost; they're stable; and they hold up well.

Bigger is better—Although they are pricier, larger wheels roll easier and can handle more weight. I've found that any wheel under 4 in. dia. catches too easily on cracks or seams in a floor, or on sawdust or other debris. For most applications, a 4-in. or 5-in. wheel will work well, although you may need to go to a larger diameter to handle very heavy items, like a lumber rack. If your shop floor is plywood or hardwood, choose larger-diameter and wider wheels to prevent floor damage.

Casters are rated for the weight they can handle, but, like power-tool horsepower ratings, caster load ratings are suspect. To avoid problems, choose a set of casters that, combined, are rated to handle at least 50% more weight than they'll actually support.

Combine fixed and swivel types—Your next consideration is whether to use fixed or swiveling casters. In

SWIVEL OR FIXED?

Swivel-base casters (left) allow you to turn the load in any direction. Fixed-base casters (right) cannot turn, but are useful where you need the base to move either straight in or out.



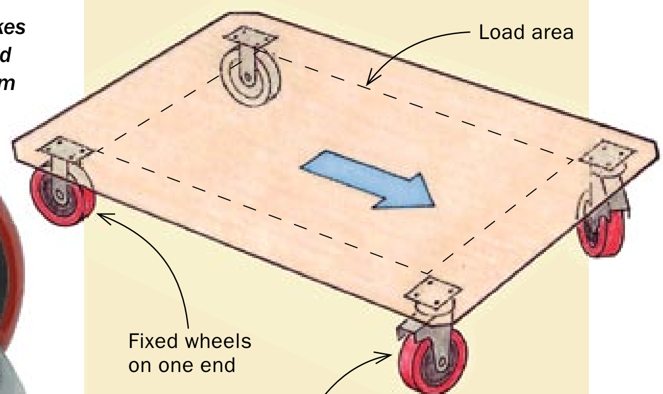
BRAKE OR NO BRAKE?

Brakes help stabilize the load. If you need a caster-mounted tool or assembly table to stay put, you need brakes on at least two of the casters. Single-lock brakes (below, left) keep the wheels from turning on their axles. Double-lock brakes (below, right) do that too, and also keep swivel casters from swiveling.



THE "SHOPPING CART" SETUP

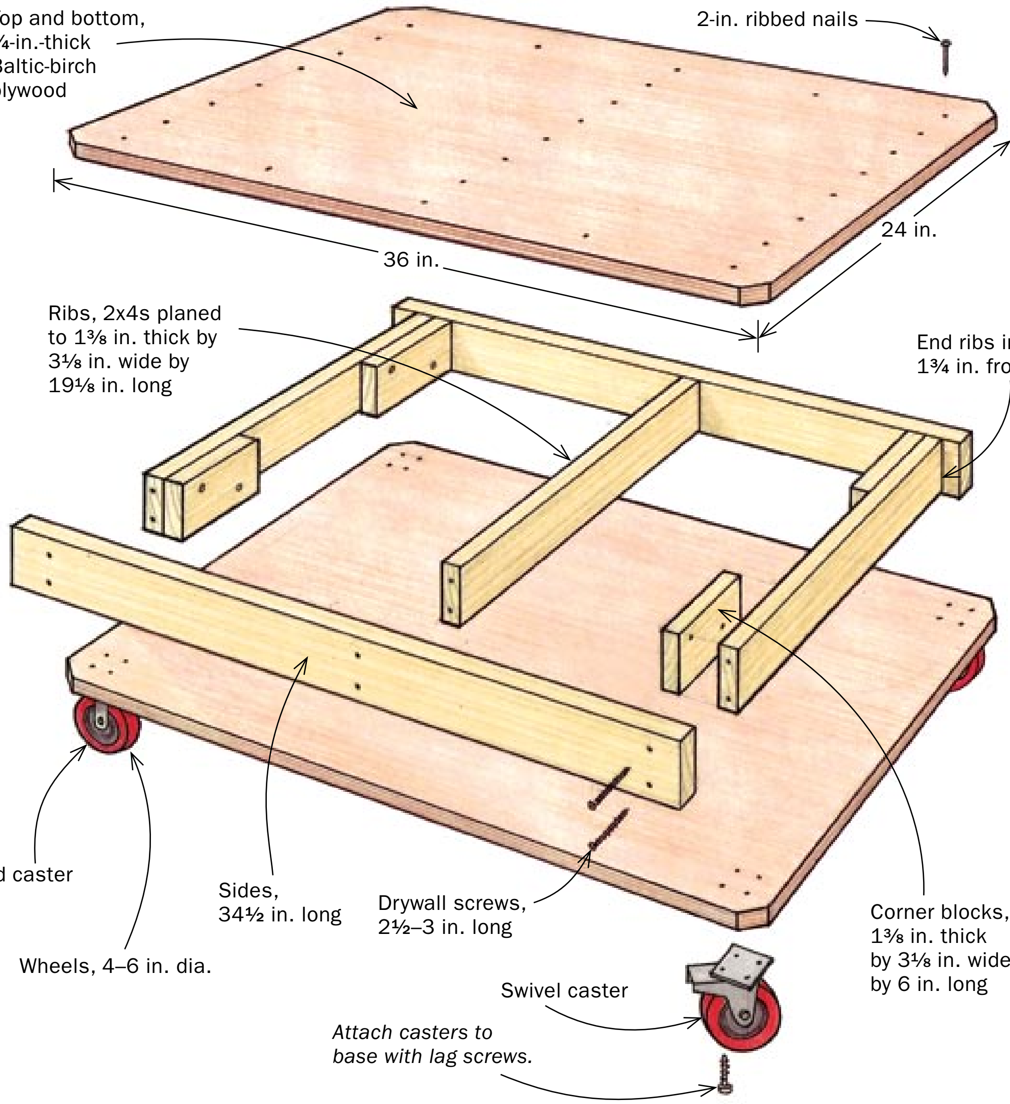
By far the most common configuration is two fixed casters on one end or side and two swivel casters on the other. This gives the unit both movability and stability (think shopping cart). The platform base should be about 6 in. wider and longer than the base of the load it carries, so the footprint of the wheels, even at their innermost positions, is not narrower than the load base.





Use a torsion-box base for furniture dollies, assembly tables, tool carts, floor-standing machines, and shop fixtures such as clamp and sheet-good racks. For stability, install the casters as close to the corners as possible. Here's a common 24-in. by 36-in. base, but yours should be sized to suit your needs.

Platform base



Attach corner blocks to support casters. *Corner blocks on this basic torsion box provide a structure where the casters are attached. White attaches the blocks with countersunk 2-in. drywall screws (left). The top is applied using a bead of construction adhesive, then ribbed nails spaced 4 in. apart (right).*





99% of shop applications, you should use two fixed and two swivel casters, the same arrangement used on shopping carts. The pairing of the two types makes it easy to steer the unit around the shop.

Double-lock is best—The final consideration is whether to use casters with brakes and, if so, whether to use the single- or double-lock type. A single-lock brake only prevents the wheel from spinning on its axis, leaving a pivoting caster free to shift from side to side. A double-lock brake stops the wheel from spinning and from swiveling on its pivoting caster. For carts and racks, either no brake or a single-lock brake is all you need. For casters under worktables and machines, use double locks to create a more stable, shift-free surface.

The best double-lock models use a foot pedal that projects over the wheel and bears directly on the tire. The other type of brake, a small lever that pivots on the caster's axle bolt, is hard to set and usually fails to lock the wheel solidly.

Now attach them correctly

None of the above means anything, of course, unless the casters are attached to a base that can support them and the load they'll carry. The base must be strong and stable, while allowing access to the brake mechanism and leaving room for the swiveling casters to pivot 360°. All of these conditions are best met with a base whose casters are as close to the corners as possible. I've come up with two simple base designs, one for platforms and the other for cabinet-style units. The designs are easy to build, locate the casters properly, and are adapted easily to almost any workshop application.

Building a platform base—The platform-style base is basically a torsion box in which the thickness of the plywood skins requires only a few cross-braces to create



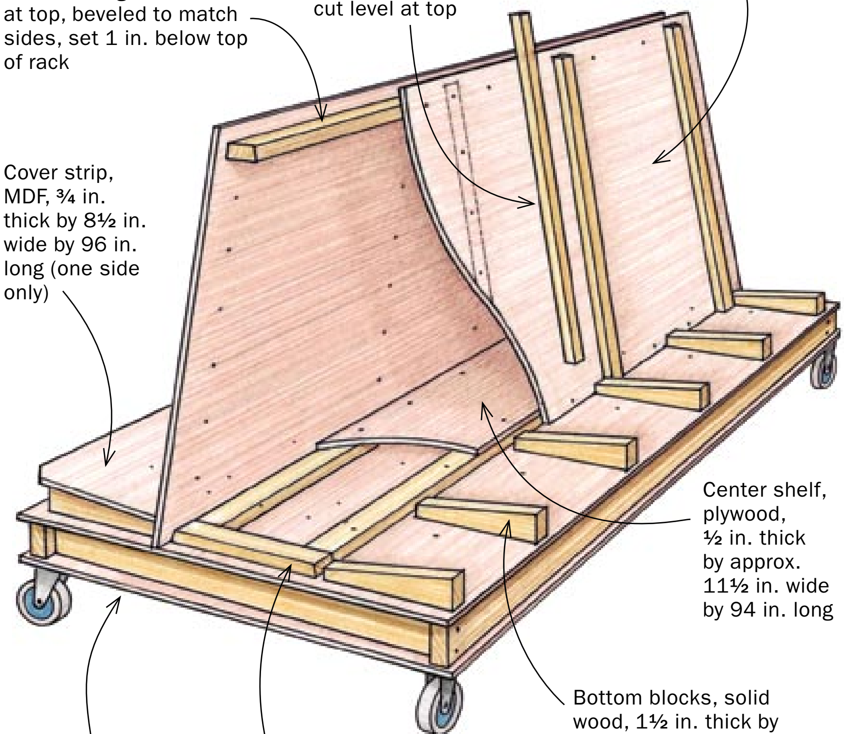
Attach the casters. *White uses 1½-in. lag screws to attach the casters securely to the base. Typically, the corner blocks will support lag screws for only three of each caster's mounting holes, but that's enough.*

Lumber rack on wheels



The strong, rigid torsion-box design of the platform base is ideal for a rolling rack for sheet goods. The key is angling the sides so that the sheets won't flop off as the rack is rolled around. The top 2x strip and the frame under the center shelf are beveled, as are the bottom blocks that help support the load. I covered one side of the blocks with an MDF strip so I could store smaller sheets easily. The blocks on the opposite side are left exposed, which leaves a gap so sheets are easy to grab at the bottom. I attached the stiffeners to the sides before attaching the sides to the top strip and the bottom frame. The triangular cubby between the sides can hold odd-size offcuts or lumber. All parts were assembled with drywall screws.

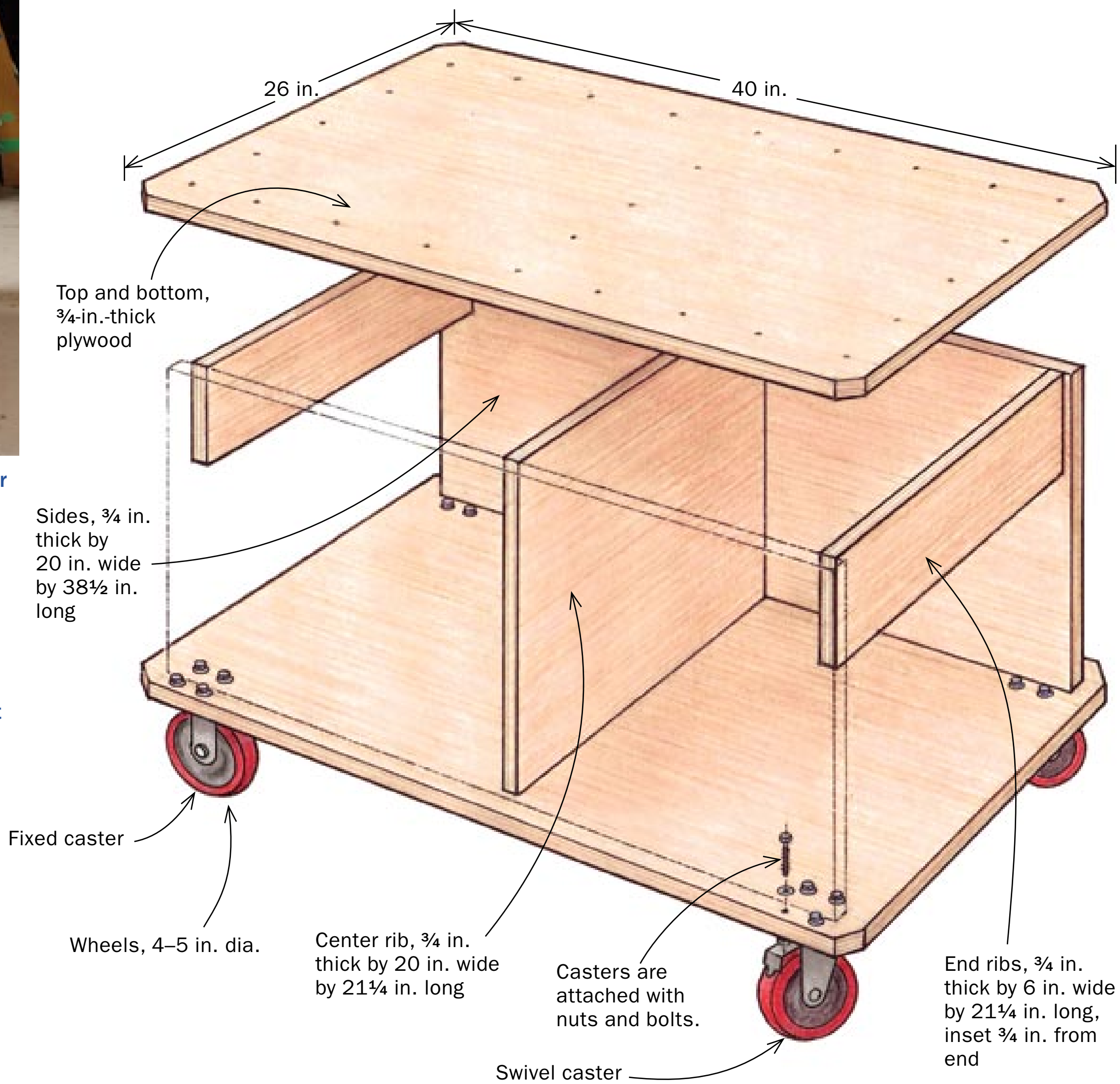
SHEET-GOODS RACK





Use this cabinet-style base for bench-mounted tools, such as thickness planers, drill presses, and miter saws. It's made entirely of Baltic-birch plywood. This 26-in. by 40-in. base is sufficient for most benchtop tools. Once again, modify measurements to suit the size you need.

Cabinet-style base



Simple butt joints suffice. *There's no need to put the cabinet base together with dadoes, rabbets, or even glue. Just make sure the edges are square, mark the screw locations carefully, predrill and countersink the holes, and attach with 2-in. deck screws for a better grip in the plywood end grain. (Note: To prevent splitting, predrill the holes all the way into the plywood end grain. Use a tapered bit, or start with a bit narrower than the screw diameter, then widen the hole in the surface piece only.)*



a very stiff assembly (see photos, p. 48). The plywood top and bottom faces overhang the 2x4 frame slightly to simplify the construction and to allow beveling of the corners. The frames are assembled with drywall screws or nails and the plywood is attached with construction adhesive and nails. The casters are attached with lag screws driven into the frame and corner blocks. This base can serve as built as a platform for furniture or tools, or it can have racks for clamps or lumber attached.

Building a cabinet base—The second design is for a cabinet-type base that could be used as a stand for a benchtop power tool or as an assembly or outfeed table, with storage underneath. The heart of the design is the inset sides that place the weight of the sides and top directly over the centerline of the casters. This allows the casters to be right out at the edge of the bottom panel for the widest and most stable base. Built from cabinet-grade plywood, the base is sturdy and very simple to construct; all of the elements are simple rectangles joined by drywall screws. To prevent the box from racking, each of the open ends of the cabinet will need either a face frame or a rib supporting the top. Once the basic box is built, any combination of drawers, open compartments, and doors can be added to suit the unit's function.

When choosing the dimensions for either style of base, keep in mind that the actual footprint of the casters will be narrower than the platform. This can make the unit tippy unless you add a few extra inches to the width of the base to compensate. For instance, if a tool stand resting directly on the floor would be stable at 18 in. wide, the equivalent unit on casters will need to be around 24 in. wide to be as stable. □

John White is the former shop manager for Fine Woodworking. *He lives and works in Vermont.*





CABINET BASE IS VERSATILE

White uses the cabinet base in a number of forms. In one iteration, it serves as a platform for several machines, such as a router table (above), a drill press, and a thickness planer. White also used the design to build a dedicated sanding station (right).



Attach casters with bolts. *Because the bottom is one piece of plywood with no corner blocks, the cabinet-base casters are attached with bolts and nuts, not lag screws. White uses a locking compound (above) or nuts with nylon inserts to keep the bolts tight.*



SOURCES OF SUPPLY

Grizzly Industrial Inc.
www.grizzly.com
800-523-4777

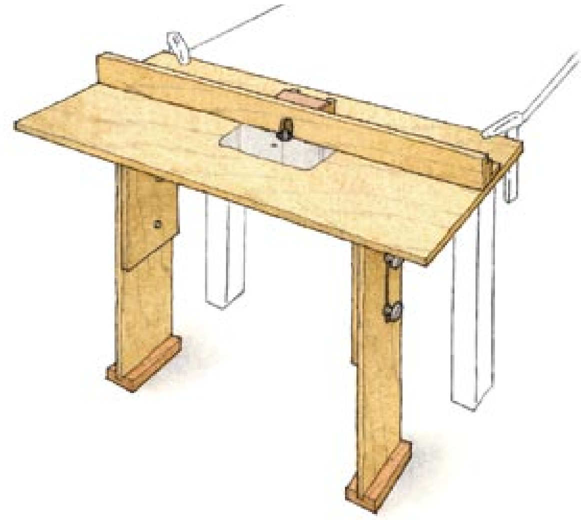
Hartville Tool
www.hartvilletool.com
800-345-2396

Rockler
www.rockler.com
800-279-4441

Woodcraft
www.woodcraft.com
800-225-1153

Woodworker's Supply
800-645-9292
www.woodworker.com

Stow-and-Go Router Table



A portable setup with big features

BY ROLAND JOHNSON

Building a router table doesn't require the expertise of NASA engineers. I've been using a simple knockdown router table in my shop for years. It's quick to make and doesn't require much in the way of materials. All you need is a half sheet of plywood, some hardwood lumber, a handful of hardware, a router mounting plate, and a router that features above-the-table adjustments. My table is adjustable in height, has a large top and built-in dust collection, and can be raised and knocked down easily.

The biggest expense is the mounting plate that holds the router in the top. You can buy these plates from JessEm, Woodpecker, or any other router accessory source. I paid about $60 for a Woodpecker mounting plate with three rings. I spent an extra $12 on a template to lay out and cut the opening for it (see photos, below).

The tabletop is 24 in. deep by 48 in. wide. Once you have it cut to size, lay out the opening for the mounting plate. Draw centerlines front to back and side to side. The mounting plate is centered on the front-to-back line, but it's shifted about 4 in. to the right of the side-to-side line. Locating the mounting plate in this way provides a long outfeed surface, which I find useful for many router-table tasks.

Online Extra

To watch a video of the table in use, go to **FineWoodworking.com/WS.**

After routing the mounting-plate opening, cut the hardwood braces that mount under the table. These braces help keep the top flat, so be sure that the edges that mate to the table are square and straight.

Next, cut the parts for the fence, dust-collection box, and leg sections. The fence base and main fence must be perfectly 90° to the tabletop. The sacrificial face is screwed to the main fence, and the dust-hood box is screwed to the fence assembly.

The fence pivots on a bolt and locks in place with a threaded knob. To install the pivot, align the front edge of the fence, including the sacrificial face, with the centerline on the tabletop. Clamp the fence in place and drill a 5⁄16-in.-dia. hole through the fence base and top.

You're now ready to put this handy table to use. Just don't forget to put it away when you're done.

Roland Johnson is a Fine Woodworking *contributing editor.*

CUT THE OPENING FOR THE MOUNTING PLATE



Mark the opening. *Johnson bought the optional template for the Woodpecker mounting plate.*



Use a jigsaw to rough out the hole. *Stay about 5⁄8 in. away from the layout lines.*



You don't need a rabbeting bit to cut a rabbet. *For this job, a 3⁄4-in. top-bearing bit will do.*



Take light passes. *Use the mounting-plate template to guide the router as you cut the rabbet.*

Photos: David Heim; drawings: Jim Richey

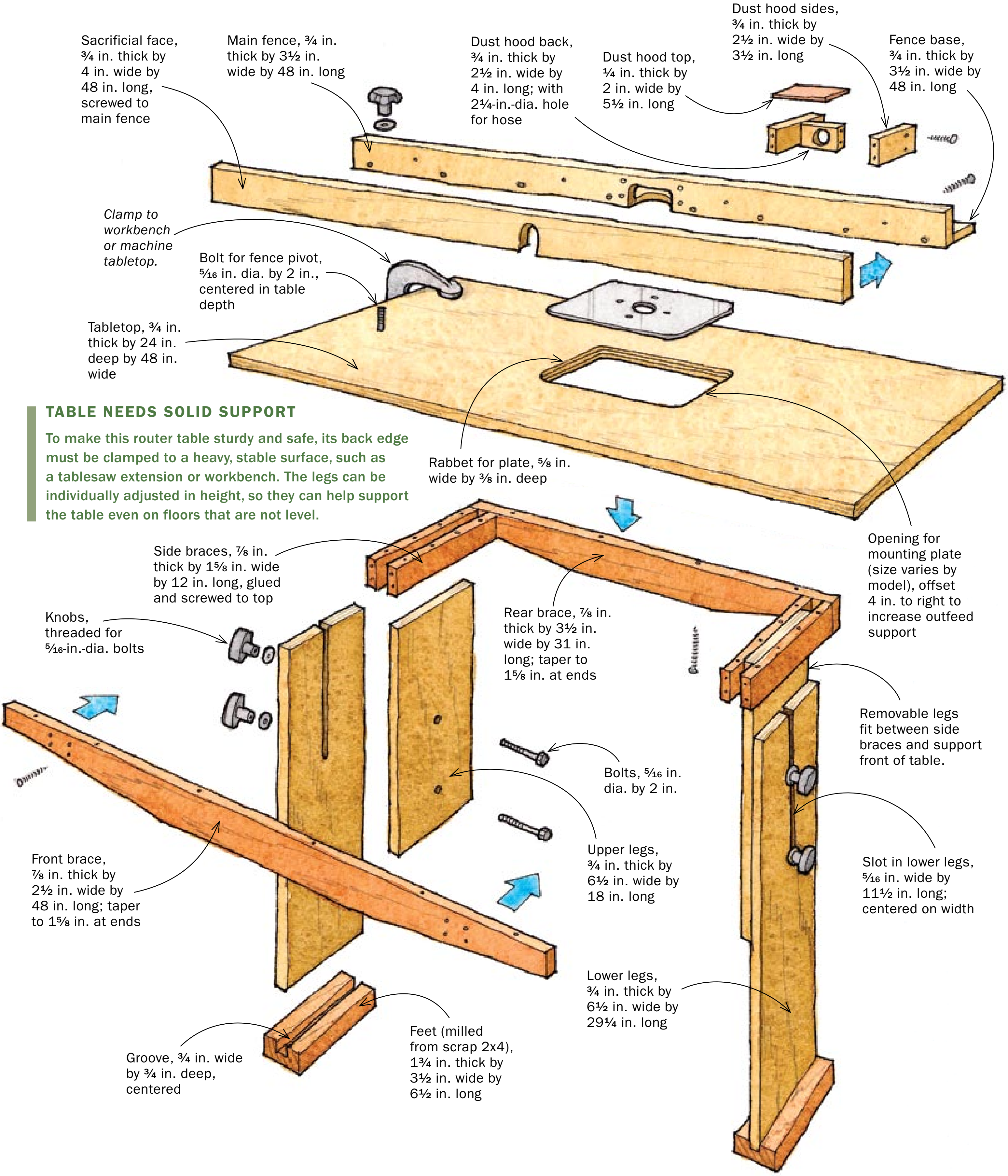


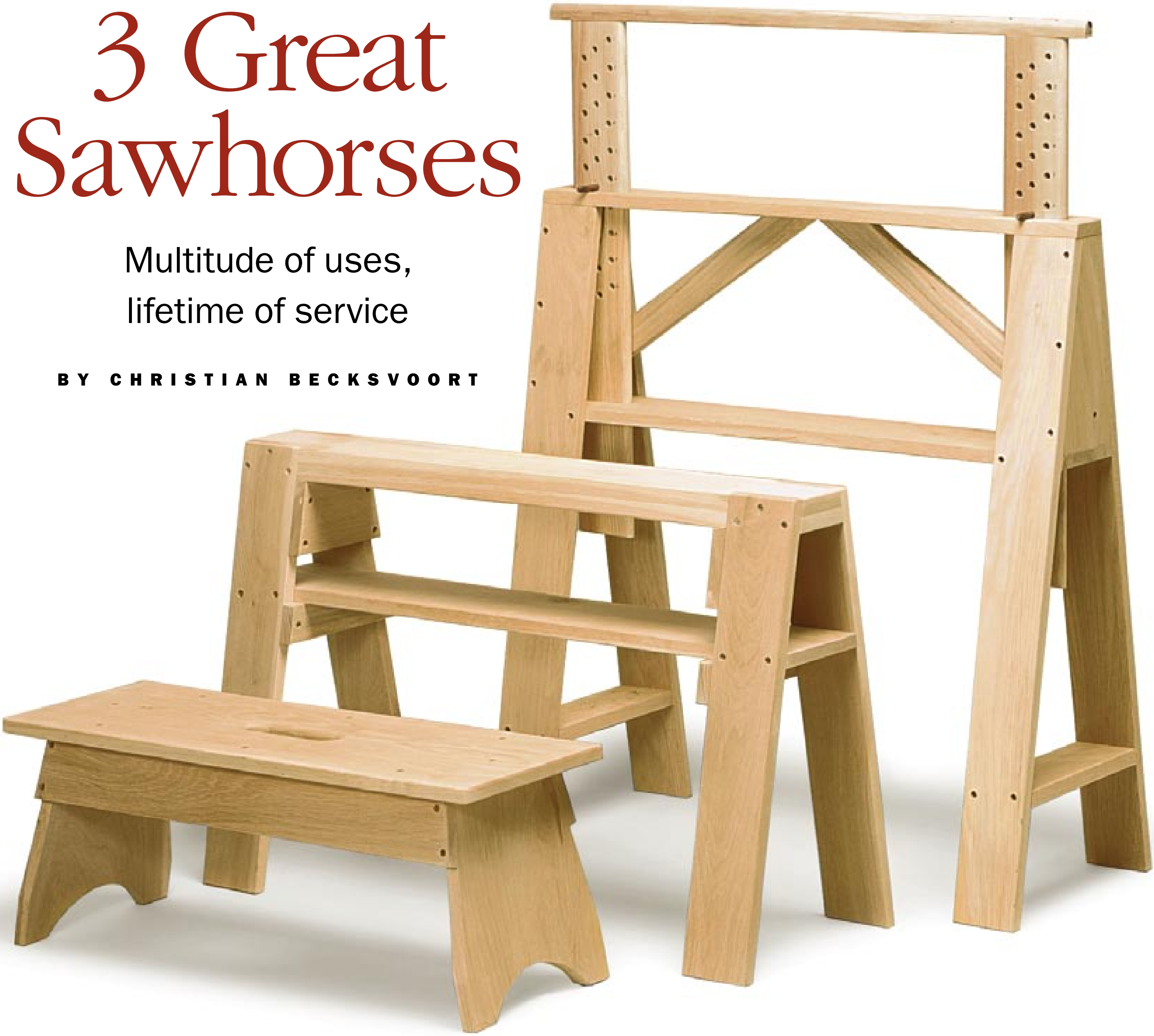
TABLE NEEDS SOLID SUPPORT

To make this router table sturdy and safe, its back edge must be clamped to a heavy, stable surface, such as a tablesaw extension or workbench. The legs can be individually adjusted in height, so they can help support the table even on floors that are not level.

3 Great Sawhorses

Multitude of uses, lifetime of service

BY CHRISTIAN BECKSVOORT



Sawhorses are an indispensable part of my shop equipment. No matter what the process or project, I reach for a horse to saw boards, to stand on, to lay out panels and joints, to hold parts, and to elevate cabinets for sanding or planing. I also use sawhorses for drill-press work supports, assembly, finishing, outdoor power carving and routing, changing lightbulbs, and even photography. I've constructed a pair each of three different heights: 1 ft., 2 ft., and 3 ft. The 3-ft. set includes height extenders for even more versatility.

Sawhorses are not fine furniture. They are designed for the roughest treatment, and I give it to them without a second thought. I built these horses quick and dirty, to be useful but sturdy. The material is whatever I happened to have on hand at the time: pine, ash, oak, fir, and even the ever-plentiful cherry scraps. For joinery I relied on butt joints held together with glue and screws.

While studying and restoring Shaker pieces, I noticed that although most of their work reflects meticulous craftsmanship and graceful design, many of their tables, stands, and cases intended for shop use are merely glued and nailed together. They had the same idea.

Christian Becksvoort is a furniture maker in New Gloucester, Maine.

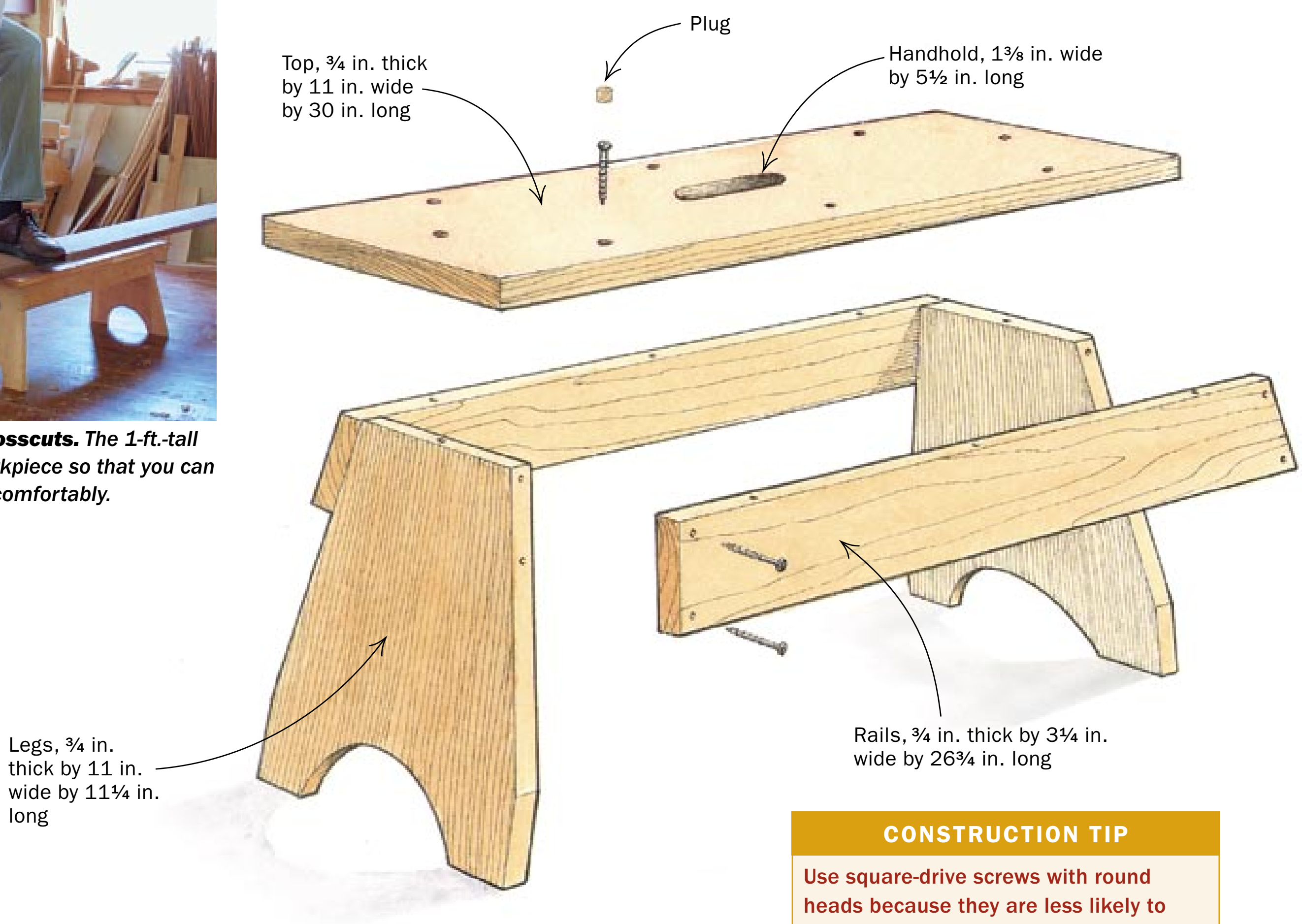
Photos, except where noted: Michael Pekovich; this page: Tim Sams

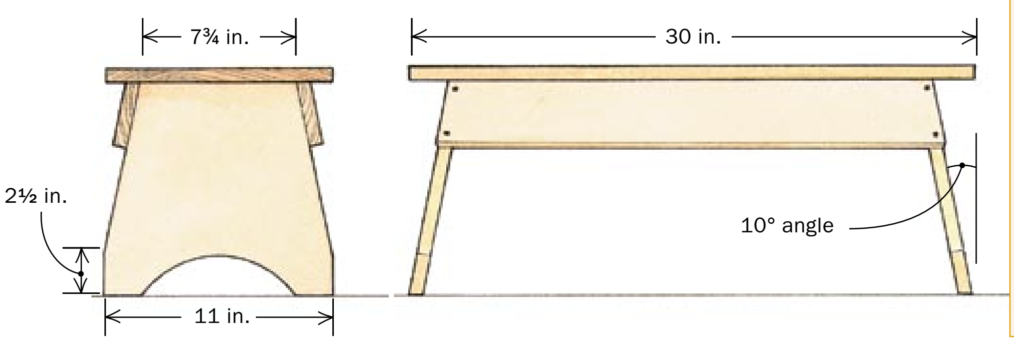


Stepping up for crosscuts. *The 1-ft.-tall horse raises the workpiece so that you can use a crosscut saw comfortably.*

SHORT HORSE IS ALSO A HANDY STEP STOOL

Essentially, this horse is a stool, but it can be used as a short bench for sawing, holding tall work in a vise, and holding casework off the floor for finishing.





CONSTRUCTION TIP

Use square-drive screws with round heads because they are less likely to strip out and, unlike flat-head screws, won't act as a wedge and split stock.



My shortest sawhorse is really a larger version of a footstool or a small bench. It's about a foot tall and is assembled with screws. Because the top of this horse is relatively large, it has a handhold in the middle to make it easy to pick up and move with one hand.

Generally, I use the short horse for sawing long planks to rough length. If I'm cutting off just a couple of inches from the end of a long plank, I'll use a pair of these horses for support under the long section. If I'm cutting the plank near the middle, I'll make the sawcut between the two horses to support the cutoff.

Most often I'll use the short horses to bring a case piece up to a comfortable working height. For example, I'm over 6 ft. tall, so a 30-in.-tall cabinet that needs to be planed or sanded is in a much better working position for me with this horse placed underneath it. When edging wide panels or case backs, I set one end into my bench vise and support the other end on the short horse. My ancient Skil belt sander weighs close to 15 lb., and I prefer to use it in the horizontal position. Consequently, when finish-sanding the top of a 5-ft.-tall cabinet, I stand on the short horse to make sanding easier. When working on a nearly completed piece, I pad the top of the horse with carpet scraps to protect the piece from

unwanted dings, dents, and scratches. And I'm not the only one who finds my short sawhorses useful. The short horse gives every *Fine Woodworking* photographer who comes into my shop a great view of work in progress on my tall workbench.

The footprint of the base is the same size as the top so that the horse is safe to stand on, and a pair can be stacked. The legs are cut at 10° along both sides and are tilted at the same angle when attaching the side rails. A "V" or half-round cutout on both ends results in four feet. The rails are screwed in place, and the top is attached to the base with screws. I plugged the screw holes to keep chips and oil from accumulating in them, and I beveled all edges with a block plane before putting this horse into service.

When I build a pair of these horses again, I'll make one improvement: The rails will be 4 in. to 6 in. wide for added strength and racking resistance. After 20 years of use, my set is starting to wobble a bit. Otherwise, I'm pretty happy with them.



Use horses in conjunction with your bench. *While a workpiece is secure in the vise, the short horse provides solid support from below.*



A pair of medium-size horses makes an impromptu workbench. *At 2 ft. tall, these horses are the right height for doing finish work on a large case piece. The carpeting protects the workpiece.*

The 2-ft. sawhorse is the workhorse in my shop. This style is easy to make and move around. I make them in pairs, and the design allows the horses to be stacked when not in use. I also stapled carpeting to the top to prevent pieces from being damaged while they are on the horses.

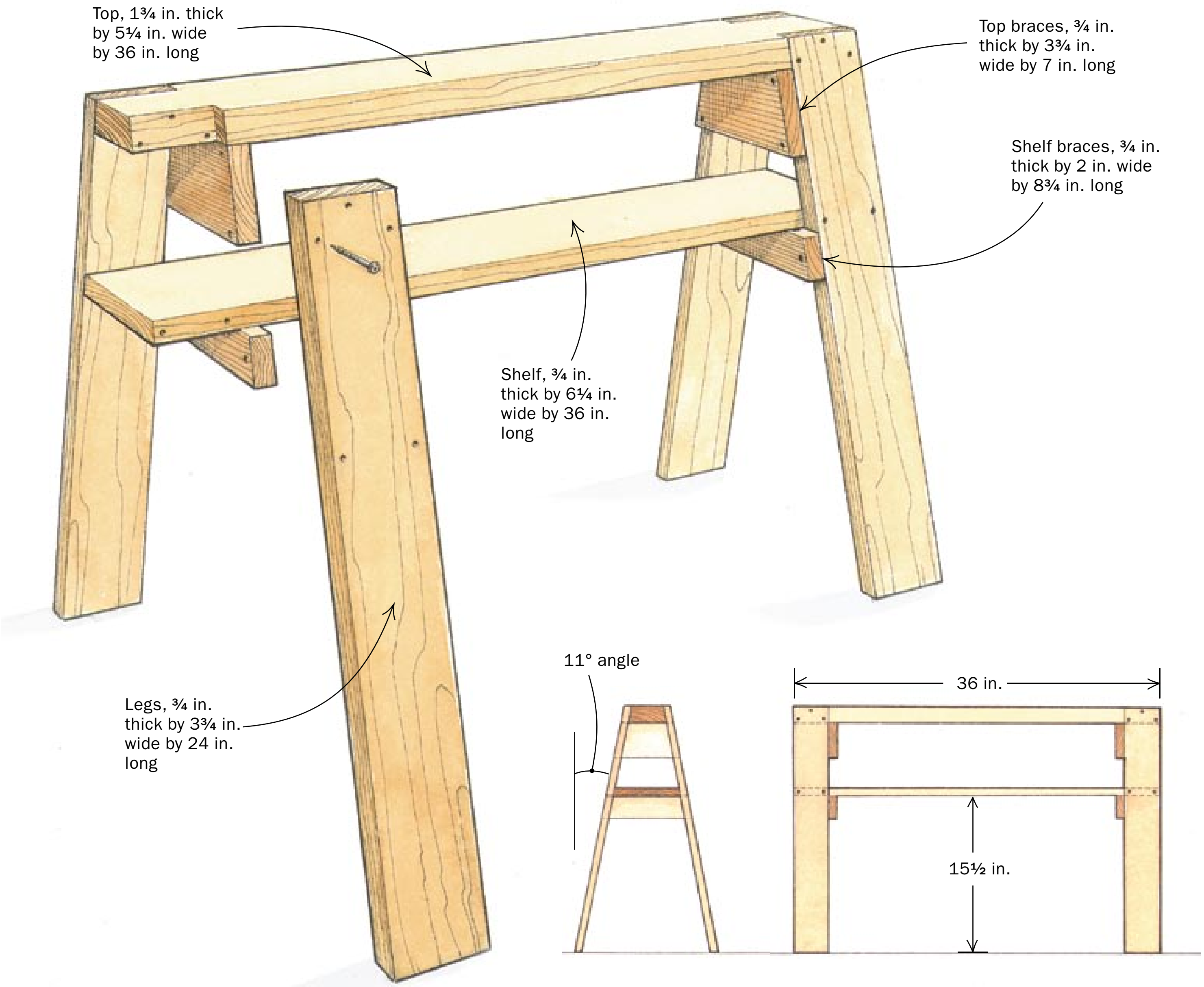
Their primary use is for holding case pieces at working height. When fitting face frames, backs, or doors, or when sanding or installing hinges, I find these midheight horses indispensable. Standing on these puppies brings me right up to the ceiling in my shop: I can change lightbulbs or sand the tops of tall cabinets. And because the braces are inboard of the legs, I can clamp onto the ends as well as the middle of the top. I sometimes use these horses to clamp case sides upright when laying out and transferring dovetails from the top to the sides. This is a real handy feature when working alone.

There are many ways to construct a 2-ft. sawhorse. On mine, the legs are let into notches in the top piece and are splayed 11°. Braces provide racking resistance in two locations, and a shelf is handy for storage or as a step. For the top,

Drawings: Heather Lambert

STACKABLE SAWHORSE IS THE PERFECT HEIGHT FOR MOST JOBS

This is a standard-size horse for general carpentry, but it also can be handy for holding case pieces. The shelf is optional, though it provides additional stability to the horse.

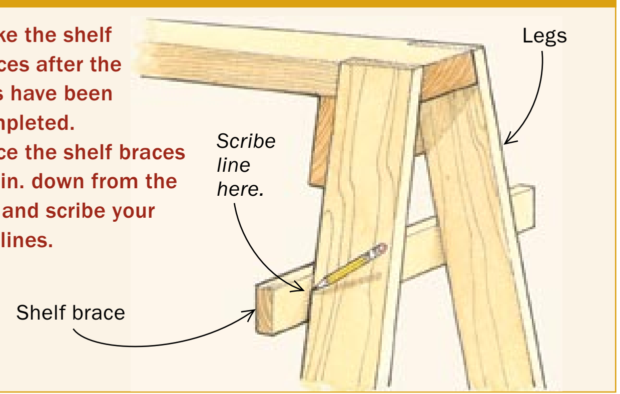


you can rip the sides of a 2x4 to 11° and simply attach the legs. Or you can use a 2x6 and let in the legs. The 2x6 gives you a wider top, which provides extra stability should you wish to stand on it. In addition to the two pairs of braces shown in the drawing, one of my 2-ft. horses has additional bracing just above the floor (see photo, facing page).

A shelf on the lower braces not only adds strength to the horse, but it also is strong enough to act as a lower step. The braces under the shelf provide enough support that I can stand on the shelf without it flexing. For a while I had side strips along the shelf that kept tools from rolling off. They worked, but they collected all sorts of debris and were difficult to keep clean, so I took them off.

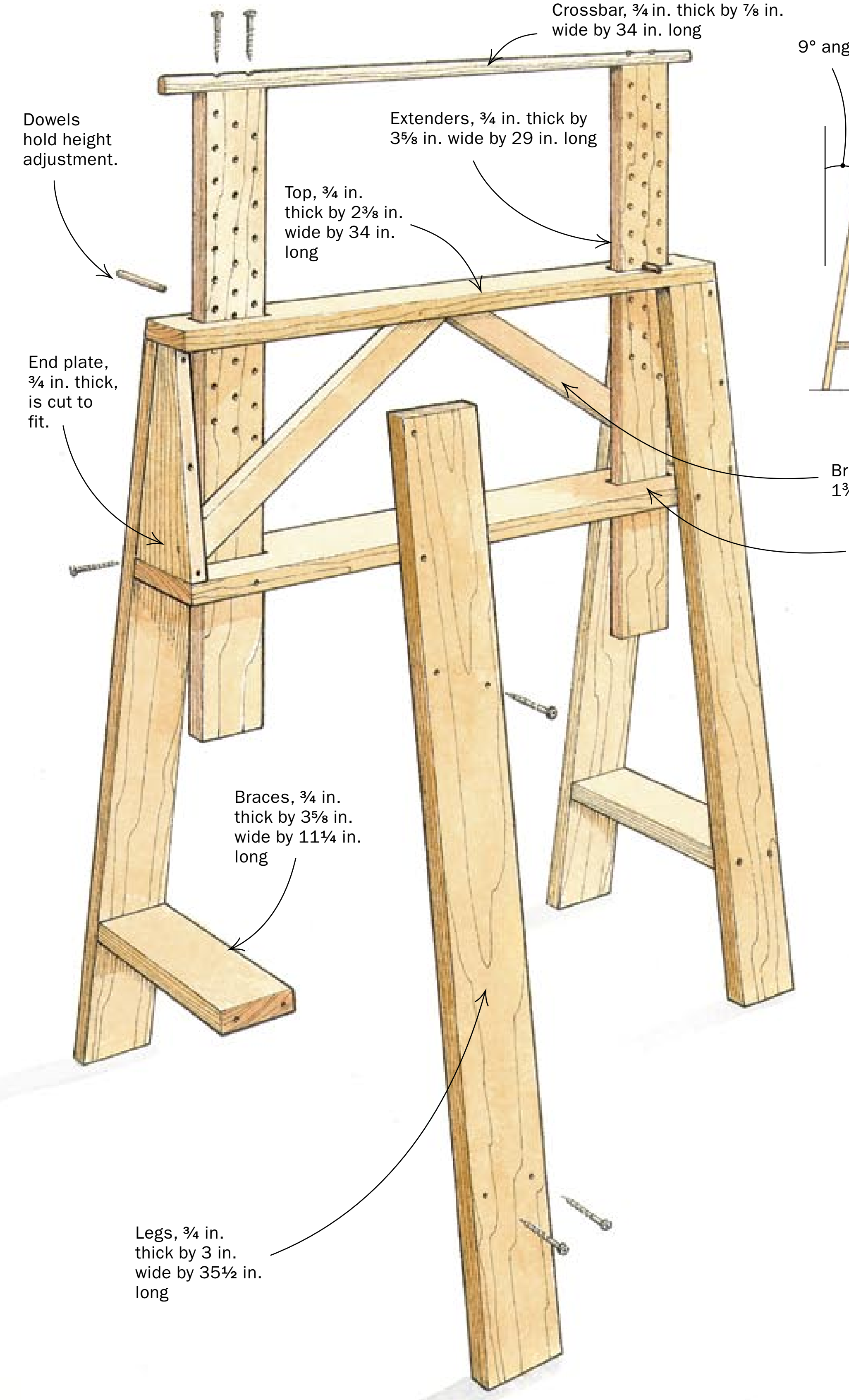
CONSTRUCTION TIP

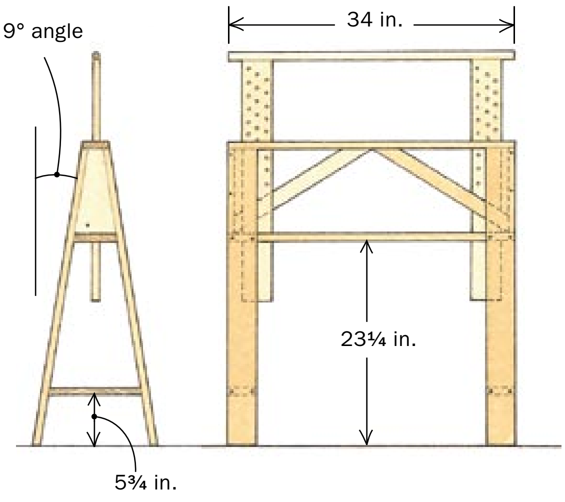
Make the shelf braces after the legs have been completed.
Place the shelf braces 8½ in. down from the top and scribe your cut lines.



ADJUSTABLE HORSE HANDLES ANY TASK

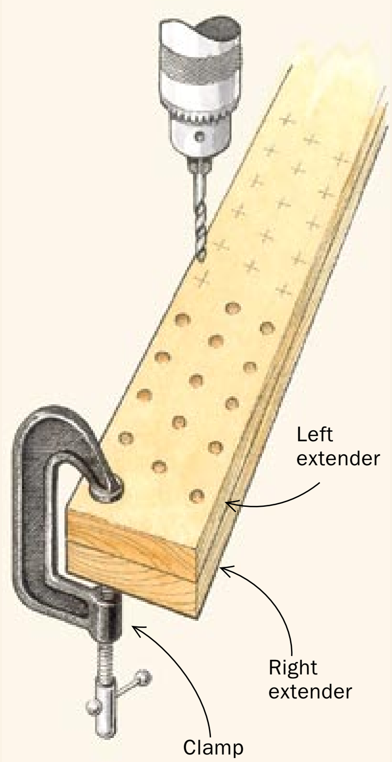
The extenders on this horse raise your work to a comfortable height. The ends of the horse are made flush so that you can clamp tall pieces to them.





CONSTRUCTION TIP

Stack your extenders together and drill the dowel holes in one step to ensure proper alignment.





Adjustable-height sawhorses are versatile. *Avoid back fatigue by raising the work to a comfortable height.*

I recently added a third pair of sawhorses that can be adjusted in height between 36 in. and 55 in.

I use these horses mainly for sanding and finishing. Even though they're 36 in. tall, I still have to bend over slightly, hence the extenders. For my height, 42 in. to 44 in. is ideal for sanding and finishing, especially tabletops. For fine, close-up work like carving or inlaying, I prefer 48 in. to 54 in. That's about mid-chest height for me, just right for the real fussy stuff. When I have messy work to do, I haul these horses outside, remove the extenders, and use them like a bench for seat carving, grinding, sanding, and routing. At the drill press, the extenders are useful for holding long work at the correct height.

The tall horses are built almost like the two-footers. The major difference is that I have enclosed the ends and added diagonal braces for strength. The extenders consist of two 3⅝-in.-wide boards connected to a ¾-in.-thick crossbar. The boards are drilled at ½-in. intervals and fit into slots in the top and the lower shelf, much like a centerboard of a sailboat. Two ⅜-in.-dia. dowels through the 25⁄64-in. holes hold the extenders at the desired height. The crossbar is padded with ¾-in.-dia. foam pipe insulation to protect the workpiece. It also provides grip to prevent panels from sliding around when they're being sanded.

Feel free to customize these horses as needed for specific applications. For example, the crossbar is fine for supporting wide panels, but it won't take the weight of a 4-in.-thick plank. A wider board or even a T-shaped crosspiece would make a good substitute. On occasion, when I use the horses as a single unit, I have scrap V boards fitted between them. Two bar clamps hold the whole unit together so that I can use it as a bench.



Height adjustment is made with a dowel. *The holes are numbered on both sides for quick alignment.*

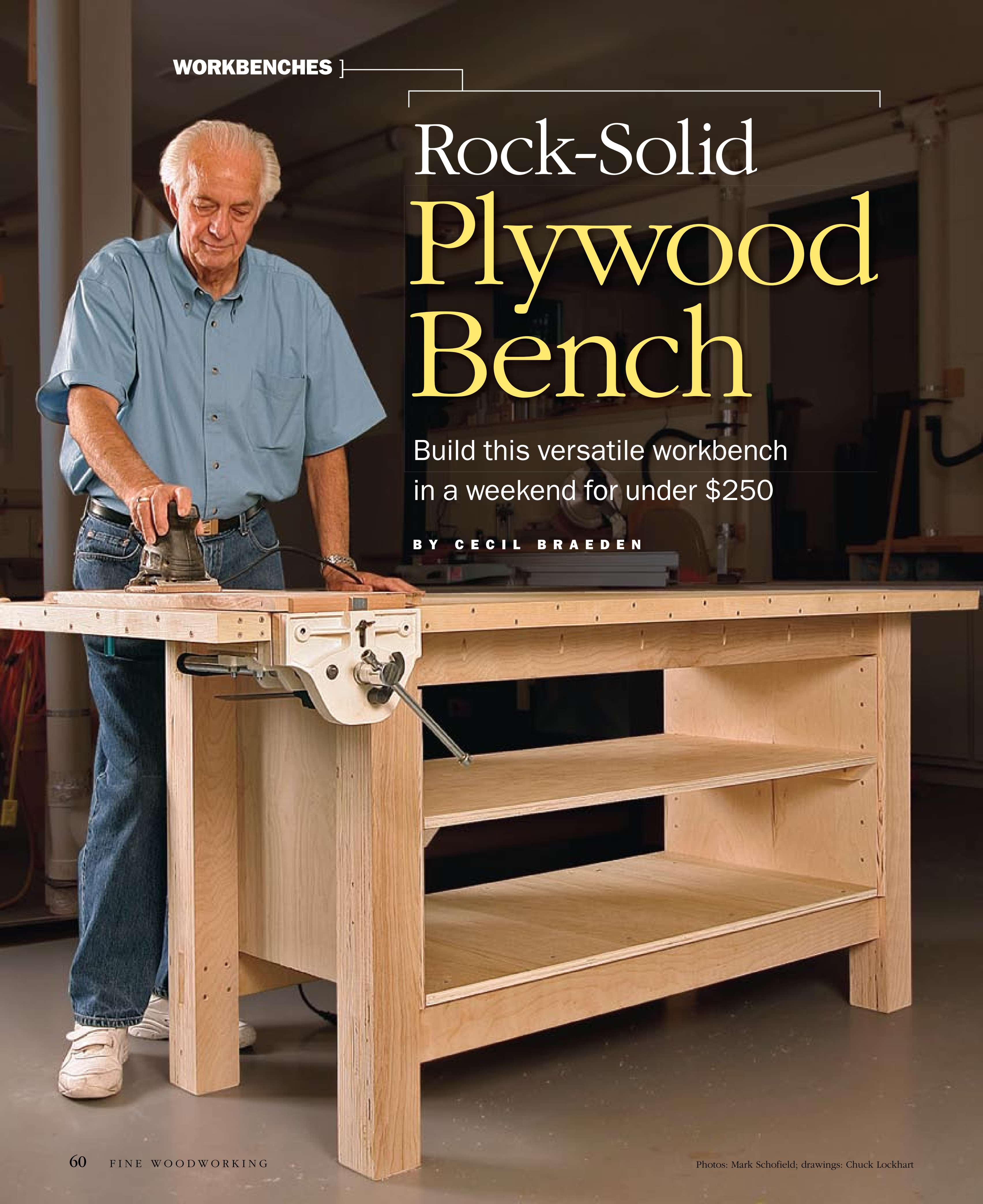


Pad the crossbars to protect your work. *Foam pipe insulation works well and easily slips on and off the top.*

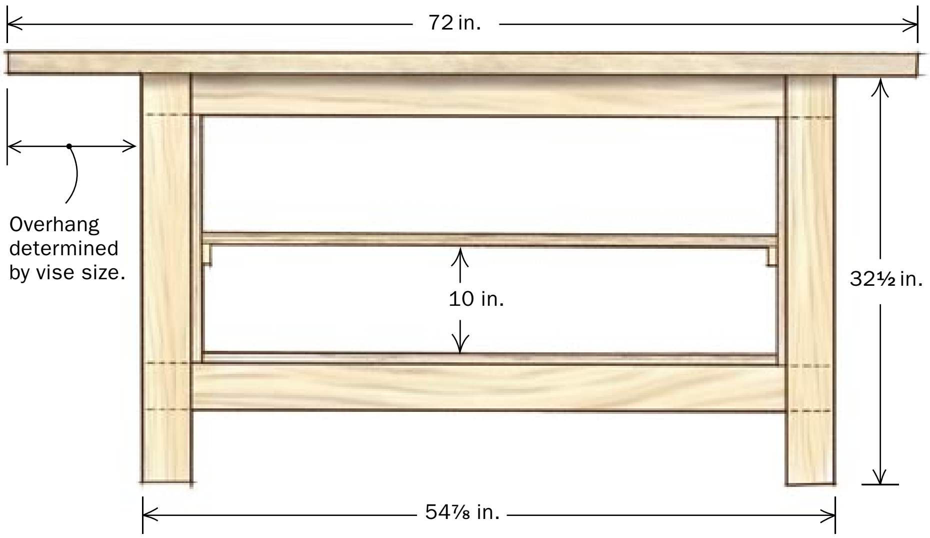
Rock-Solid Plywood Bench

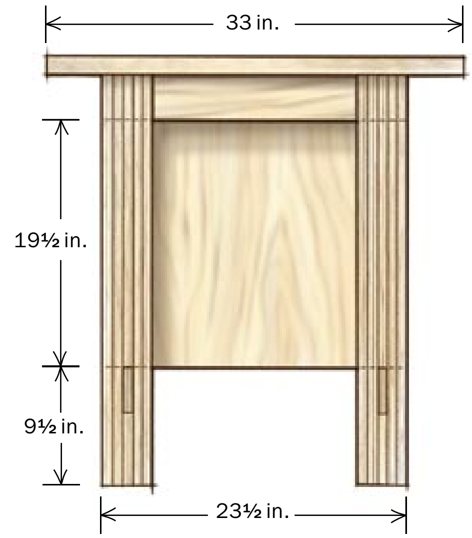
Build this versatile workbench in a weekend for under $250

BY CECIL BRAEDEN

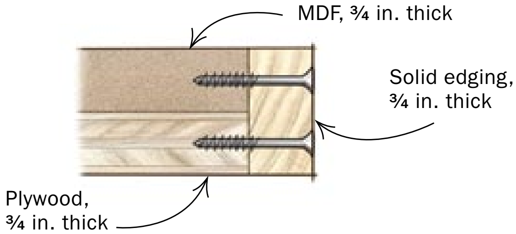


Photos: Mark Schofield; drawings: Chuck Lockhart





BENCHTOP DETAIL



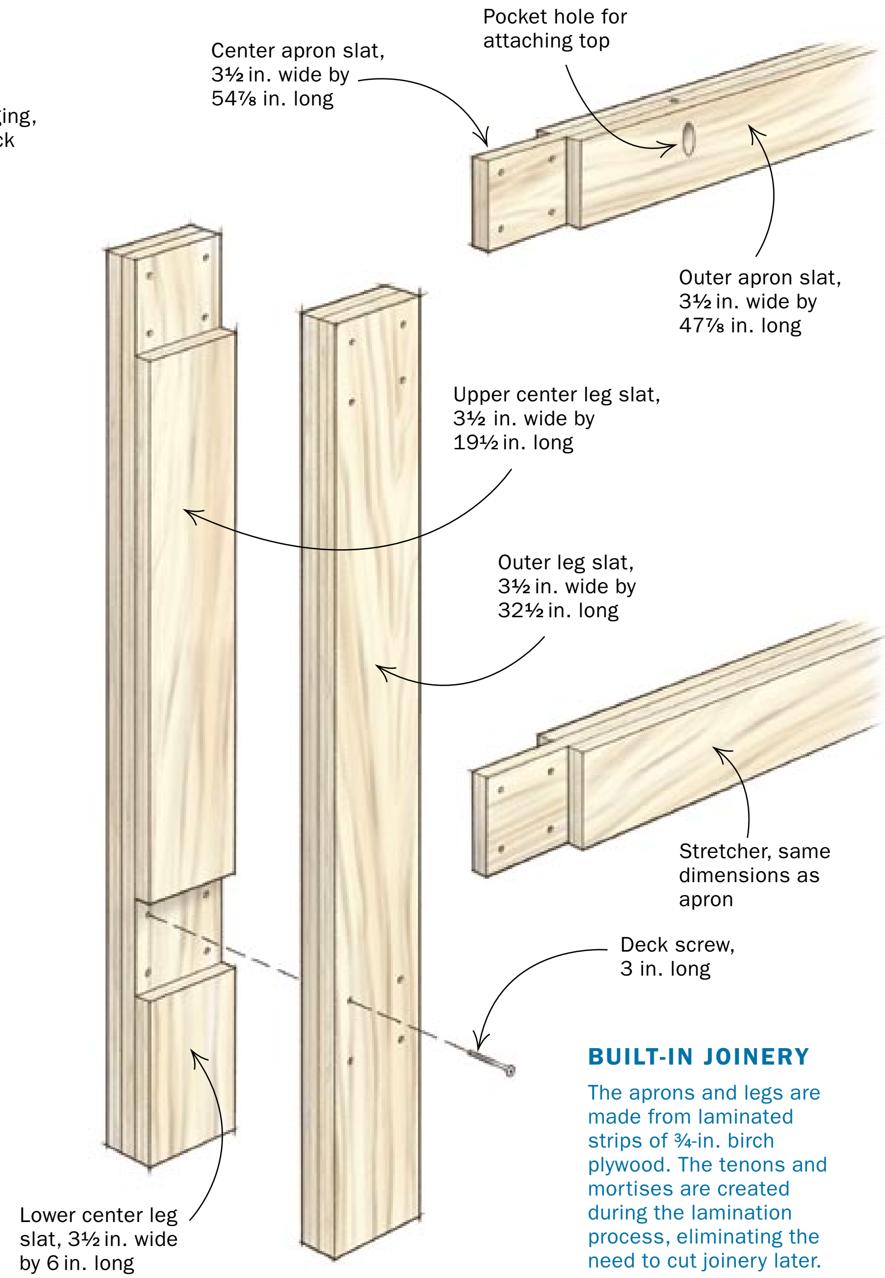
I had wanted to build a sturdy workbench for some time but was put off by the cost and complexity of a traditional hardwood bench. I knew that such benches derive much of their strength and rigidity from the mortises and tenons that join the framework, and I wondered if there was a way to combine this joinery with the inherent strength, rigidity, and dimensional accuracy of plywood. The design I created has a base of laminated sections of plywood and a top of plywood and medium-density fiberboard (MDF).

An advantage of this design is that the piece can be built without a planer or jointer, perfect for someone just getting started in woodworking. For under $250 including a vise, I have a bench with the rigidity I desired without breaking the bank.

Design the bench, create a cut plan, and begin

This method of construction can be adapted to almost any size and type of bench: You could even construct just the base and purchase a ready-made hardwood top. My bench is 33 in. wide by 72 in. long by 34 in. tall, a comfortable working height for me. It is also ⅛ in. lower than my tablesaw, allowing me to use the bench as an auxiliary outfeed table. The cut plan I used (see p. 62) allows you to create a bench with legs up to 36 in. long, giving a bench height of 37½ in.

All base components—legs, aprons, and stretchers—are laminations made from 3 9/16-in.-wide slats of ¾-in.-thick plywood. Set the tablesaw's fence and rip all the strips without changing the setting. You always



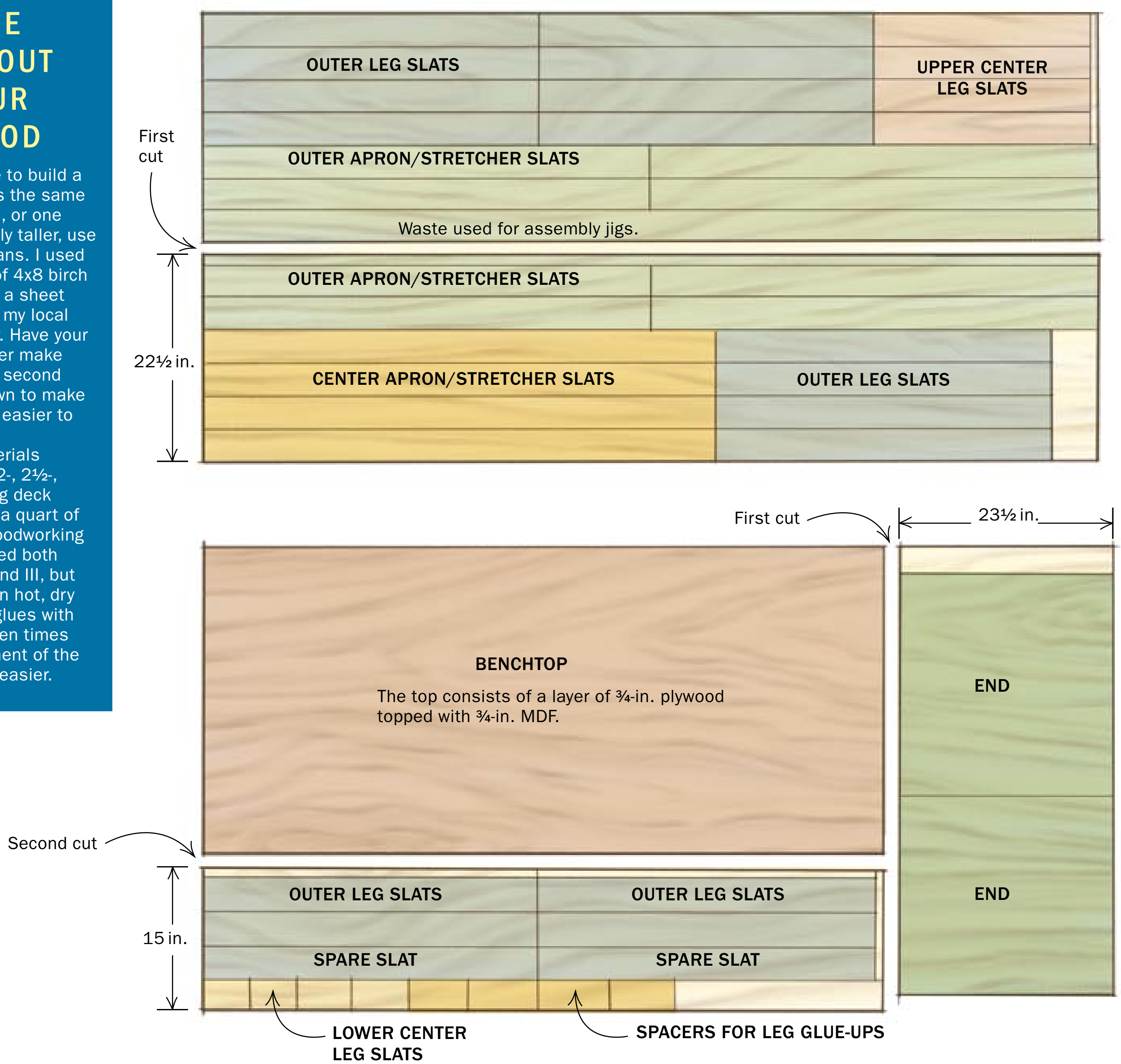
BUILT-IN JOINERY

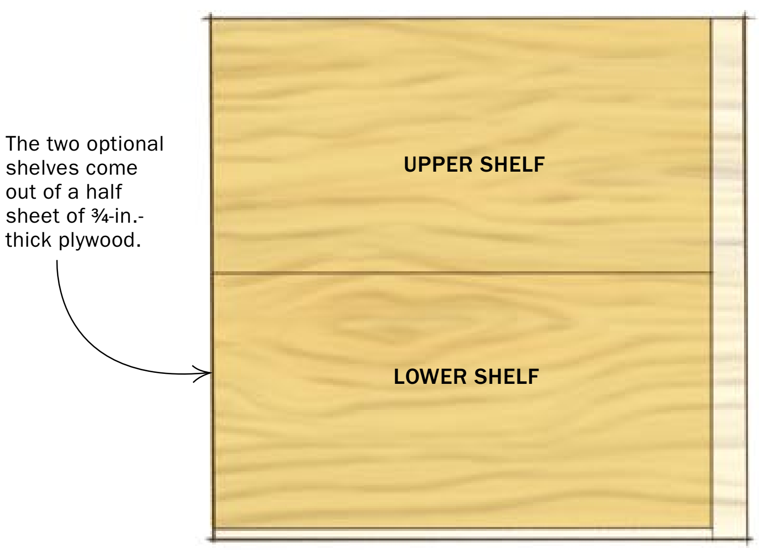
The aprons and legs are made from laminated strips of ¾-in. birch plywood. The tenons and mortises are created during the lamination process, eliminating the need to cut joinery later.

GET THE MOST OUT OF YOUR PLYWOOD

If you decide to build a bench that is the same size as mine, or one that is slightly taller, use these cut plans. I used 2½ sheets of 4x8 birch plywood and a sheet of MDF from my local home center. Have your plywood seller make the first and second cuts as shown to make the material easier to handle.

Other materials needed are 2-, 2½-, and 3-in.-long deck screws, and a quart of fresh PVA woodworking glue. I've used both Titebond II and III, but particularly in hot, dry conditions, glues with extended open times make alignment of the laminations easier.





will get some tearout when you cut plywood: This can be minimized with a zero-clearance insert on the tablesaw, but in any case rip with the show side of the plywood up. If you do get some tearout, lightly sand away any splinters and keep the tearout side inward when assembling the components.

The last step before laminating the components is to drill pocket holes every 6 in. on one side of the two outer apron pieces to attach the top with pocket screws. Or you can use the battens described on p. 64.

Glue-up requires quick work, attention to detail

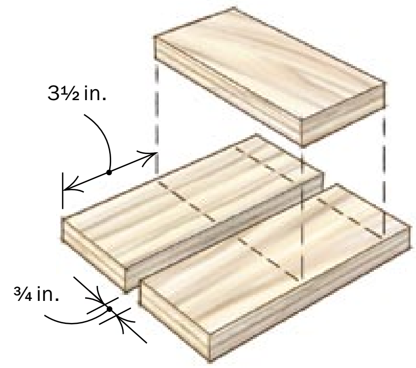
Even with glue that has a moderate amount of open time, you must work quickly, so do a dry run first and have all components in order. I apply the glue to all mating surfaces with a disposable brush that has the bristles trimmed, but a roller would work. Glue the laminates on a flat surface protected by waxed paper.



Construct the aprons and stretchers. *These parts consist of a center strip of plywood that includes the two tenons, and two shorter outer strips that form the shoulders of the tenon. Have multiple clamps ready for use.*

A SIMPLE JIG AIDS APRON ASSEMBLY

When gluing the stretchers and aprons, use a jig to align the center slat at the proper offset to create the tenon.



Assemble and glue stretchers and aprons—Make sure all like pieces are trimmed to exactly the same length. Draw a line 3½ in. from both ends of the longer center-slat pieces, and mark the ends of both sides with an "X" to indicate non-glue areas. If you are using pocket holes on the aprons, make sure the holes are facing outward and upward.

Glue the three pieces of each component together, being careful not to get any glue on the tenon ends. Turn the assembly on edge so that the plies are facing up and insert one end in the apron jig (see drawing, top right). As you apply clamping pressure, keep the slats aligned and pushed against the jig to maintain the 3½-in. tenon and even cheeks. When the glue is dry, run both exposed-ply sides of each component through the tablesaw to clean them up.

Next, make the legs—Prior to assembly, make the spacer blocks (see photos, p. 64) and wrap about 5 in. of each with clear tape. Used to create the lower mortise on each leg, the spacer is driven out after the leg has dried. Tape prevents glue from sticking to the spacer. The leg stack consists of two outside slats, the lower center piece, the spacer, the upper center piece, and two more outside slats. Locate the upper and lower mortise areas and mark both mating surfaces so that you will remember not to apply glue there.

A simple L-shaped jig helps to lay up the legs accurately. Glue the slats together, remembering to insert the spacer. After assembly, turn the stack so that the spacer is sticking up. Using both sides of the jig, keep the ends and edges of each slat in perfect alignment and the center slats pressed tightly against the spacer as you apply clamping pressure. Apply two small clamps to both outside pairs of slats that form the upper mortise.

After the glue has set, make cleanup cuts on the tablesaw. Use sandpaper to slightly chamfer the bottom edges of the finished legs to prevent splintering of the outer veneer if the bench is dragged across the floor.

Assemble the frame sides, then join them with plywood panels

Start by dry-fitting the tenon on each end of a stretcher into its respective mortise. If a tenon extends beyond the leg, trim it flush or slightly recessed. Lay a leg on a flat surface protected with waxed paper. Apply glue to the mortise and tenon, then insert the tenon and clamp lightly. Use a carpenter's square to bring the stretcher and leg to exactly 90°, and tighten the clamp. Remove the excess glue with a damp cloth, put the joint aside to set, and assemble the second leg and stretcher.

Once the glue has set, remove the clamps and lay the leg/stretcher down with the inside facing up. Drill four countersunk pilot holes at least 2½ in. deep into each joint and drive in waxed 3-in. deck screws. Reinforcing the joints in this manner may not be

Tip:
Once you spread the glue you'll have to work quickly, so do a dry run first and have all the components in order.



Leg assembly. *Insert a taped spacer block to hold open the lower mortise. An L-shaped jig keeps the sections aligned. Use a generous amount of glue, but don't apply glue to those areas that face the spacer block.*

GLUING THE LEGS





Clamping the leg. *When the sections have been glued together, turn the assembly upward and apply the clamps. Waxed paper protects the work surface. When the glue has dried, knock out the taped spacer block with a mallet and a thin piece of wood to reveal the mortise.*

necessary, but it is very cheap insurance that the joints will hold forever.

Stand the assembly on the floor with the stretcher pointing up. Place waxed paper under the apron mortise; apply glue to the mortise and insert an apron tenon, being sure the pocket holes are oriented properly. Check for 90º and clamp the apron with a bar clamp. When the joint is dry, reinforce it with screws and then attach the other leg in the same manner.

The benchtop should rest on the aprons, not the legs, so if the top of a leg is higher than the apron tenon, trim it flush. Sand the exposed joints on the legs to remove glue residue.

If you are not using pocket screws to attach the top, prepare a couple of 2-in.-square battens with countersunk holes in two directions. Clamp the battens flush with the top inside edge of the aprons and attach them with 3-in. deck screws.

Stand the front and rear assemblies on their legs on a level floor, and cut two pieces of plywood to fit between the stretchers and aprons and to the desired width of the frame. These sides will serve as the end stretchers. There will be space to install an end vise above the side of the bench if desired. Chamfer the edges of the sides. Drill countersunk holes every 3 in., 1¾ in. from both edges to locate the screws in the center ply of the legs. Clamp the sides in place with the edges flush with the outside edges of the legs. Be sure to check that the frame is square by measuring the diagonal between opposite corners; adjust until the



Clean up the edges. *After the legs, aprons, and stretchers have been assembled, run both edges past a sawblade to clean up glue residue and leave them at the final 3½-in. width. Cut the first edges with the fence at 3$\frac{9}{16}$ in., and the opposite edges at 3½ in.*

distances are even, then tighten the clamps. Now drill pilot holes 1½ in. deep through the previously drilled countersunk holes, and drive 2½-in. deck screws.

Next, add two plywood shelves, the lower one attached to the front and rear stretchers with 2-in. screws, and the upper one screwed to battens attached with 3-in. screws through the end stretchers into the legs. Because the shelves, sides, and top are screwed on, the whole bench can be disassembled for moving.

Make and attach the top

If you are making your own top, lay the layers upside down, making sure one end of the assembly is flush, and screw them together using countersunk screws that will not go through the top layer. Cut the other sides flush using a circular saw and straightedge or the tablesaw.

Ask a friend to help place the top on the frame and position as desired. Mark the corners of the legs on the underside of the top. Then turn the top over and mark the holes for the vise(s) on the bottom side so that you can drill small holes through. You may have to add a spacer block to bring the vise jaws level with the top. Turn the top back over and use a spade bit to drill recesses for the bolt heads at each of the small holes. Then drill for the bolts and attach the vise. At this point you can attach the top: Place it on the bench frame and secure it with the pocket holes or battens.

To protect the soft edge of the MDF top, I screwed a solid-wood edging around the entire benchtop, leaving a gap for the vise. Drill holes for benchdogs (if desired), and you are done. If you plan to use this bench primarily for glue-ups or finishing, a good choice would be to laminate the top; otherwise, apply a clear finish or just leave it natural. □

Cecil Braeden is a woodworker near Anacortes, Wash.

ASSEMBLING THE BASE







Begin with the frame sides. *Insert the stretcher and apron into the leg, making sure they meet at exactly 90° (1). Reinforce the joints with four 3-in. deck screws. With the side frame resting on the floor, add the second leg (2). Finally, add the plywood end stretchers (3). Clamp them in place, check the base for squareness, then attach with screws.*

Ultimate Workbench

Workhorse design combines the best of old and new

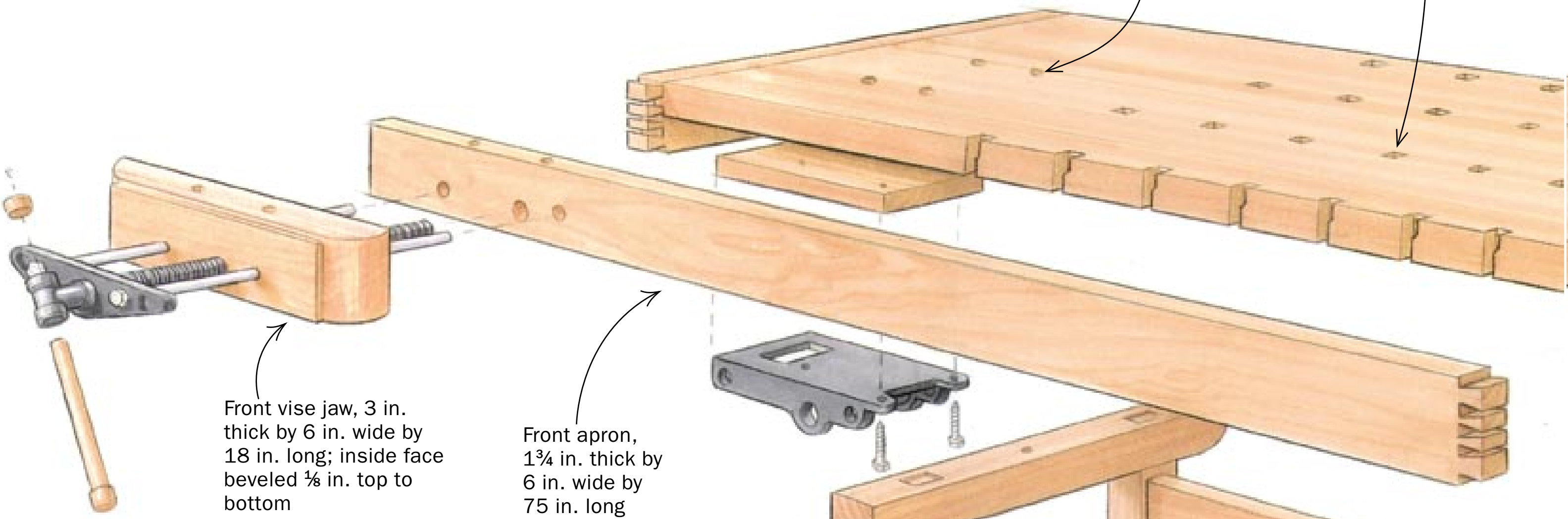
BY LON SCHLEINING

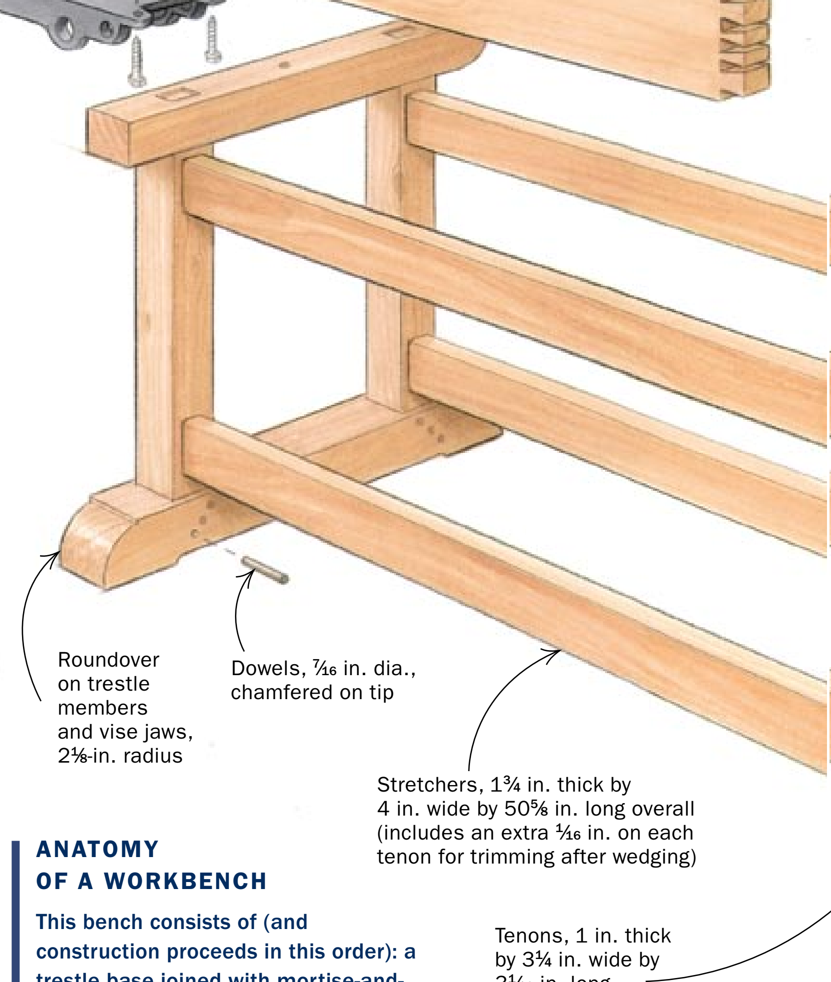
Several *Fine Woodworking* editors and I collaborated on designing an essential workbench for today's woodworker, one that is straightforward to build without compromising performance. This bench was designed to be a tool—more workhorse than showpiece.

Although the design is built on the foundation of the dozens that have graced the pages of *Fine Woodworking* since 1976, we did not include traditional components simply for history's sake, and we took advantage of modern innovations. We wanted this bench to be a project that most woodworkers could build using tools found in an average small shop: tablesaw, portable planer, crosscut saw, router, drill press, and hand tools. The only heavy-duty tool I used was a 3-hp tablesaw. Ripping lots of 8/4 maple puts a strain on even a large saw, so use a clean, sharp blade.

A durable workbench requires beefy parts

Avid woodworkers themselves, *Fine Woodworking* editors regularly visit shops across the country, and they see a wide array of workbench configurations. Like all woodworkers, they know what

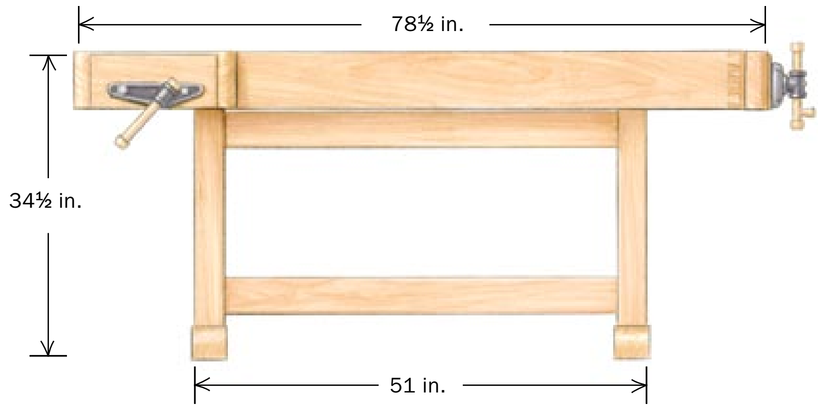


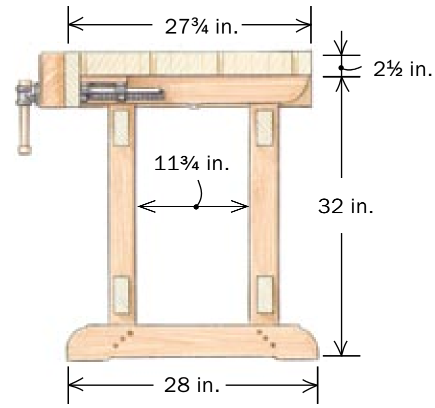


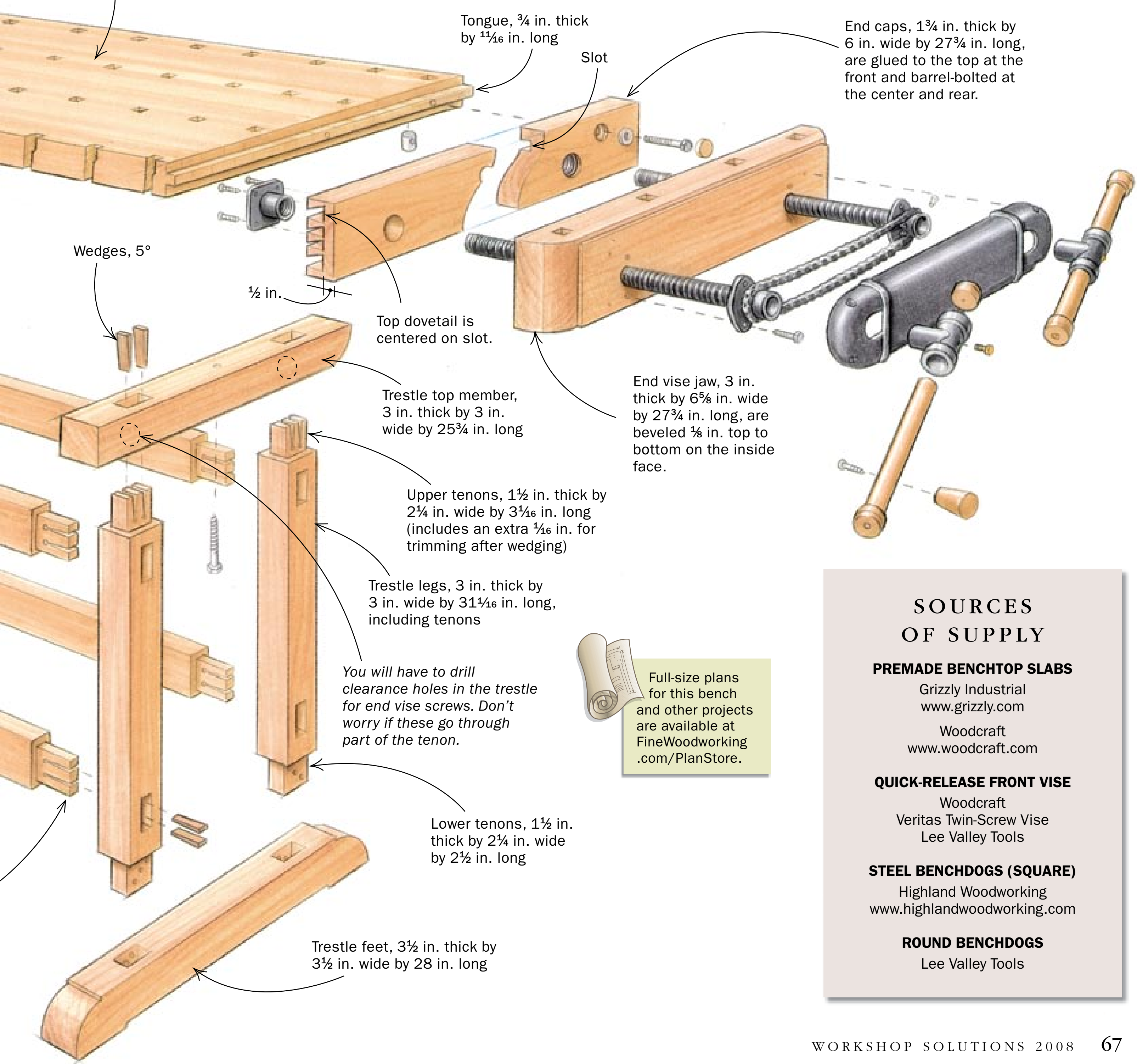
ANATOMY OF A WORKBENCH

This bench consists of (and construction proceeds in this order): a trestle base joined with mortise-and-tenon joints; a thick top laminated from boards set on edge; and front and end vises, both with wood jaws.

Photos: Asa Christiana; drawings: Bob La Pointe







Full-size plans for this bench and other projects are available at FineWoodworking .com/PlanStore.

SOURCES OF SUPPLY

PREMADE BENCHTOP SLABS

Grizzly Industrial
www.grizzly.com

Woodcraft
www.woodcraft.com

QUICK-RELEASE FRONT VISE

Woodcraft
Veritas Twin-Screw Vise
Lee Valley Tools

STEEL BENCHDOGS (SQUARE)

Highland Woodworking
www.highlandwoodworking.com

ROUND BENCHDOGS

Lee Valley Tools

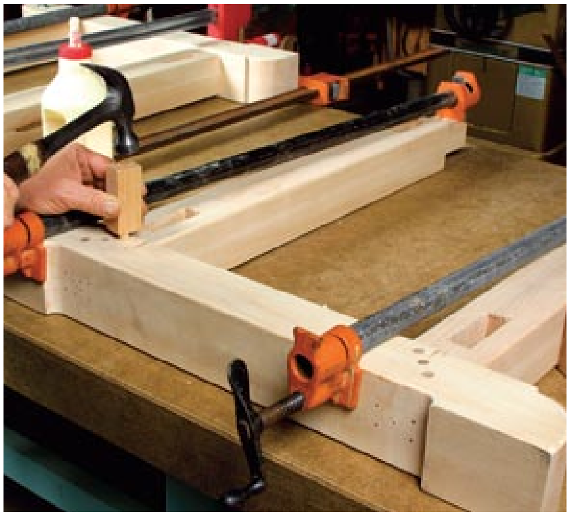
BASE ASSEMBLY

BLIND MORTISE-AND-TENON JOINTS ARE PINNED FOR STRENGTH

The deep mortise-and-tenon joints are either draw-pinned or wedged to ensure decades of rigidity. First, assemble the trestles, then add the long stretchers to complete the base.







The feet are pinned to the legs. *Start by drilling the dowel holes in the feet, dry-fitting the joints, and transferring (left) the dowel-hole locations to the tenons. Then use a center punch (center) to offset those locations slightly on the tenons, which draws the tenon shoulders tight against the trestle. Last, apply glue to all surfaces, assemble the joint, and drive home the dowels (right).*

they like and don't like. In the end we all compromised a bit, but we reached a solid consensus. My involvement arose from having spent a year researching and writing a book on workbenches (*The Workbench*; 2005, The Taunton Press). I was commissioned to finalize this design, write the article, and build the bench.

A thick, solid top—We decided on an overall size of 28 in. wide by 6 ft. long. Add a few inches for vise jaws, and it's a nice, big top. The editors thought a 2-in.-thick top would be plenty, with extra thickness at the edges, but I made this top 2½ in. thick because it wasn't much more difficult to mill and laminate thicker pieces. However, if you start with a premade bench slab, the standard 1¾-in. thickness offers plenty of mass and solidity for serious hand-tool use, especially after adding the thicker apron and end caps.

Gluing up the slab allowed me to machine the square benchdog holes before the pieces were assembled. Round dog holes might be a better option for a premade slab because square ones are best cut while the top slab is in pieces.

Heavy, rigid base—I wanted the benchtop and base to be nicely proportioned. Many benches I've seen look like top-heavy slabs on spindly legs. Also, it was important that the bench not rack or skid across the floor under heavy handplaning. A thick trestle base, joined with pinned or wedged mortise-and-tenons, guarantees stability. I laminated 8/4 lumber to make these thick members (and the top slab) because 8/4 is readily available in most regions.

Splitting the stretchers, two high and two low, leaves a perfect opening for a cabinet with drawers (see "Under-Bench Tool Cabinet," pp. 74-79). A traditional single, wide stretcher would have saved time, but it also would have blocked this natural storage area.

Innovative vises—Hundreds of woodworkers probably would say they could not get through a day without a conventional tail

A jig makes easy work of mortises

There are 16 mortises (and tenons) in the base but only two different sizes. Make two mortising jigs to speed up layout and guide the chisels. The jig is made from three blocks glued and screwed together, with a fence attached on each side to hug the workpiece.



Locate and lay out the mortises. *With the jig, this job should go quickly.*



Drill out most of the waste. *The layout lines will guide you. For the blind mortises, set the drill press's depth stop.*



Chop out the rest with chisels. *Remove most of the material with a ½-in. chisel before switching to a wider one. The jig will guide the chisels precisely.*

THROUGH-TENONS ARE WEDGED



Wedge the top members and stretchers. *The slots in the tenons are angled 5° to match the wedge angle. A hole is drilled at the base of each slot to prevent splitting. Apply glue to all surfaces, including the wedges and slots; assemble the joint; and drive home the wedges (above), using a block of wood to protect them from direct blows. Last, connect the two trestles with the upper and lower stretchers (below), wedging their tenons in place.*

vise, which is designed primarily for clamping things flat on the benchtop between dogs. Others would say the same for a shoulder vise, which offers the capability of clamping workpieces between its jaws without interference from guide bars or screws. The Veritas Twin-Screw Vise incorporates some of the capabilities of both types, allowing long boards or large panels to be clamped with benchdogs as well as clamping an upright board up to 15 in. wide for operations such as dovetailing. The two screws are connected with a chain, preventing the jaws from racking no matter where a workpiece is located or which row of dog holes is used.

I've always loved the look and performance of thick wooden jaws on a front vise but found it tedious to crank the long screw in and out constantly. I was tempted to install a cast-iron, quick-action Record-style vise, until I found a German-made quick-action vise screw and guide bars at Woodcraft. That allowed me to design a wooden front jaw to match the one I made for the Veritas end vise and still have quick action. However, a cast-iron vise also would have been fine, and a patternmaker's vise is an interesting option.

Both square and round benchdogs—Used in conjunction with an end vise, tail vise, or other hold-down, benchdogs help hold a piece securely for planing or other handwork. There are different types of dogs—round and square, wooden and metal—and all have advantages. Although I prefer square, steel ones, lots of accessories are designed to fit into ¾-in. round holes, so I incorporated both types into the bench. For the end vise, I milled square dog



BENCHTOP GLUE-UP

MAKE UP THE TOP SLAB IN SECTIONS

The benchtop is made of 8/4 maple, set on edge. Make the top in sections narrow enough to fit through the thickness planer.



Joint and plane the pieces. *Run them through the planer on edge to ensure uniformity.*



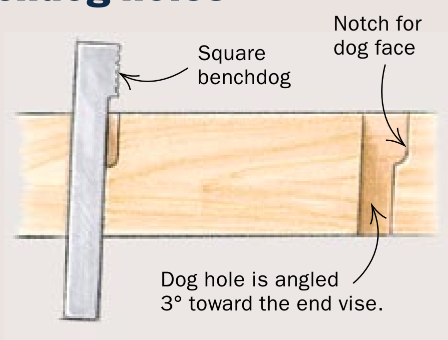
Glue up the top. *The base makes a level glue-up platform, but protect it from drips. Use a notched card to spread glue.*



Use cauls to keep the slab flat. *Wrap them with clear tape for easy cleanup. Snug them down first, then clamp across the width.*

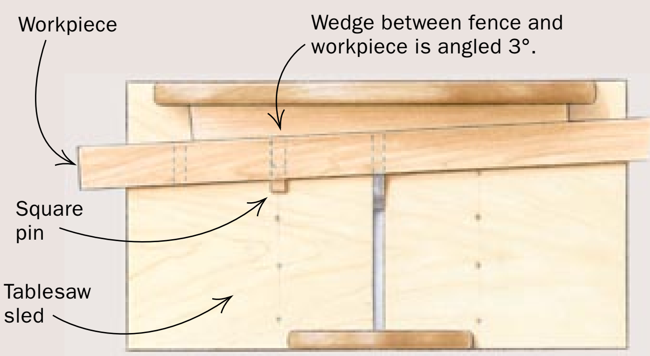
Milling benchdog holes

Cut the holes for the square benchdogs with a dado blade before glue-up. The notches for the dog faces can be routed or chopped out with a chisel.



Dado the dog holes. *Use a crosscut sled with a wedge against the fence to cut the slots at a 3° angle. A square pin sets the distance between dog slots.*





TOP VIEW OF SLED

holes to fit specific steel dogs. But I can make wood ones if I choose, fitting them to the holes for the metal dogs.

I ran two rows of ¾-in. round dog holes for the front vise. This gives me the option of using round dogs as well as hold-downs and holdfasts, which require ¾-in. holes. The round dog holes also provide the option of locating and securing jigs with ¾-in. dowel pins.

No tool tray—I like tool trays, but many woodworkers think they are only good for collecting debris. Although this design lacks one, a tool tray could be attached easily to the back of the benchtop. Keep in mind that the large space between the stretchers will house a small chest of drawers for protected storage close at hand.

Build the base first

It's more glamorous to build the top than the base. But if you build the base first, you can use it for gluing up the top slab. Then, when the top is ready, you can set it on the base to finish installing the vises. Wedged mortise-and-tenons join the legs and stretchers, creating strong resistance to racking; pegged mortise-and-tenons join legs to feet. Laminating two layers of 8/4 material (each 1¾ in. thick after surfacing) creates the right thickness for the base members. Mill the legs and top crossmembers down to 3 in. square but leave the feet at 3½ in. square.

Leave the stretchers the full 1¾ in. in thickness and rip them ⅜ in. oversize in width to allow them to move. When a wide plank is ripped into narrower pieces, tension in it is released, resulting in boards that bow one way or the other. Let the stretcher stock sit for two days, straighten and rip it to rough width, then run it through a portable planer on edge to clean each edge and bring the pieces to final width. If there's any fitting to be done, it's easier to do it on the tenons, so cut the mortises first, using a four-sided guide block to help with the chisel work. Then cut the tenons on the tablesaw, using a dado set.

Cutting the thumbnail profile—For the next task, cutting a large thumbnail profile on the feet, it will be worth your time to install a sharp new blade on the bandsaw. Before cutting the curve, I used a tablesaw and a crosscut sled to cut the small step at the top



Flatten the slab. *A five-board section of the top slab is narrow enough to fit through a benchtop planer.*



Now glue three sections into one big slab. *Place a try square across the dog holes and use a long bar clamp diagonally to correct any misalignment. Again, use lots of clamps and cauls to keep the sections level.*

of the profile. After the bandsaw cut, the smoothing went quickly using a rasp and some files, followed by sandpaper.

Assembling the base—Start with the two trestle assemblies; it's critical that they be flat and square. After the dowels have been driven home and the glue has set, dry-fit and then glue and wedge the stretchers in place. Put glue in the mortises and on the tenons as well as on the wedges and in the wedge slots. At every step of the way, measure diagonally to make sure everything stays square, and sight across the trestle tops to be sure the assembly doesn't twist as you clamp it. Your eye will pick up minute variations.

Build the top

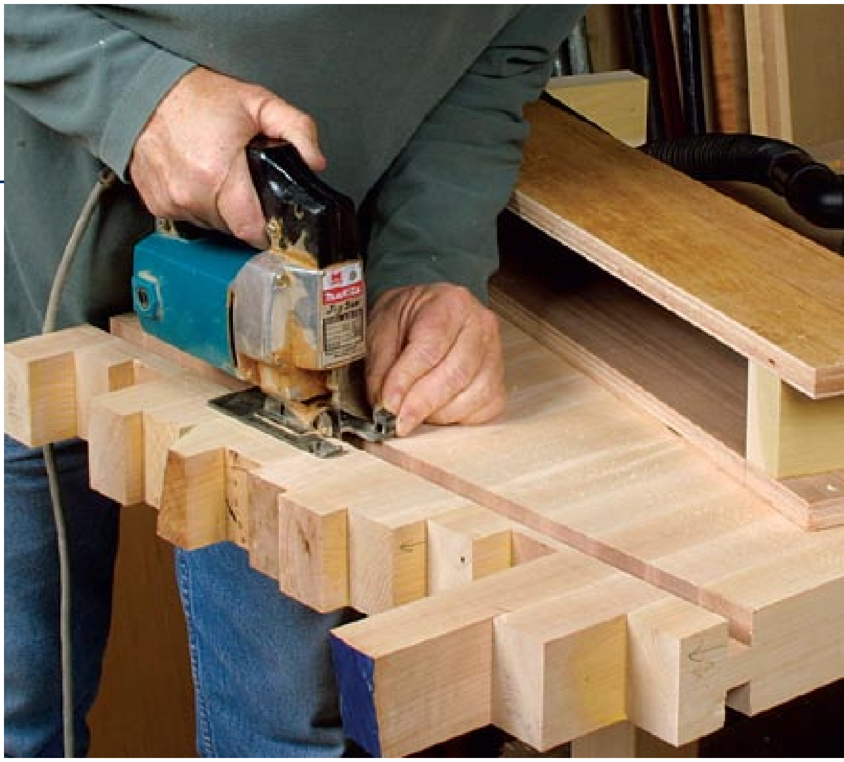
The boards for the top are plainsawn 8/4 stock set on edge and laminated face to face. The top's finished thickness is 2½ in., but you can expect some bowing when you rip the boards from wider stock, so rip the boards for the slab just under 3 in. wide. Once the strips have stabilized for a day or two, joint them straight on one edge, rip them on the tablesaw to about 2¾ in., and then plane them on edge to about 2⅝ in. This leaves the pieces ⅛ in. oversize to allow for finish planing after each section is glued up. Cut the slots for the square dogs while the pieces are separate.

Most woodworkers have a portable surface planer capable of planing a 12-in.-wide board. So glue up and mill the 26-in. top slab in three sections of five boards, each able to fit through the planer and easier to handle than the full slab.

Clamping with cauls is a two-step process. First, align the boards by applying clamp pressure to the cauls. After the boards are in line, clamp them together horizontally. Aside from straight cauls,

TRIM THE ENDS OF THE TOP IN TWO STEPS





Use the simple two-fence jig shown. *Rout deep slots in both sides of the slab, then use a jigsaw to cut off the waste (right), leaving square shoulders and a tongue that will fit into the end caps.*

Because of the half-blind dovetails, the end caps and front apron must be fitted and attached to the bench one at a time, from right to left, as are the vises.



Cut the right-hand set of half-blind dovetails. *First, cut the tails in the front apron, and then clamp the front apron in place with the right-hand end cap behind it to transfer the layout of the dovetails.*



Attach the large vise nuts to the back of the end cap. *Also, finish cutting and fitting the dovetails.*

the other key to success is a flat gluing surface. The top cross-members on the base form the perfect platform to prevent the top from twisting during glue-up.

A damp (not wet) toothbrush makes short work of cleaning the glue out of the dog holes as long as you make sure this is done immediately after the slab is clamped up. Once the glue has set for an hour or so, remove the cauls and scrape off the excess glue. Let each slab cure overnight before moving on to the next one.

Plane the sections before gluing up the entire slab—If the cauls have been placed correctly, the glued slab sections should be flat with no twist. Remove any leftover glue from the top surfaces. Then, with the top surface of the slabs down on the planer bed, run them through, taking light cuts until the bottom surface is clean. Turn the slabs top-surface-up and run them through the planer again, taking light cuts until the top surface is clean. Turn them over once more and plane the underside until you reach the 2½-in. thickness.

Gluing together the slabs is a lot like gluing up the individual sections. Again, use the top crossmembers on the base and lots of cauls to keep the pieces aligned. Then it's simple to close the last of the glue joints. However, check the dog-hole locations with a square to be sure they all will be the same distance from the end vise.

A neat trick for trimming the slab to length—Not many of us own a saw capable of accurately crosscutting a very heavy slab almost 2½ ft. wide and more than 6 ft. long. For this project, a simple router jig will allow you, in one operation, both to trim each end accurately and to create some necessary joinery (see bottom photos, p. 71). By cutting deep dadoes on the top and bottom of the slab, you will form a tongue, which fits into a slot milled into the end cap. Cut the remaining ¾-in. tongue to length with a jigsaw (this is not an important glue surface, so it's not a critical cut). Cut the mating slots in the end caps using a dado set on the tablesaw.

Install the end caps and front apron—The end caps cover the end grain of the top slab and help keep the slab flat. The right-hand end cap also serves as the rear jaw for the end vise. The front apron beefs up the thickness at this critical work area and serves as the rear jaw for the front vise. I not only needed a strong mechanical joint holding the front apron to the end caps, but I also wanted the areas that act as vise jaws to remain flat, with no end grain protruding as it would if I used through-dovetails or finger joints at the corners. Half-blind dovetails seemed to be the perfect solution, oriented as shown in the drawing on pp. 66-67.

After cutting the joinery but before gluing the end caps and front rail in place, use a drill press to bore the holes for the vise hardware. Mount the end caps with cross-barrel bolts. The Veritas vise includes four of these bolts; use two for each end cap. Apply glue only along the front 3 in. or 4 in. of the tongue and the groove. This limits wood movement of the slab toward the back of the bench.

The front apron is attached to the slab with glue only (and help from the half-blind dovetails).

Mount the vises and attach the top

Both vises come with thorough instructions, making the hardware straightforward to mount. The twin-screw vise attaches to the bench rather simply, with its two large screws passing through large nuts attached to the inner face of the end cap.

It's critical that holes in the front and rear jaws align perfectly, so drill them at the same time. The length of the chain determines the distance between holes, so careful layout is in order. The vertical location of the holes is determined by adding 1½ in. to



Now for the front vise. *Start by attaching the mounting bracket under the benchtop. The blocking under the bracket will increase the clamping capacity.*



Locate the clearance holes in the front apron. *Clamp the front apron accurately in place and tap a brad-point drill bit through the holes in the hardware to transfer their locations. Drill the holes in the front apron and front vise jaw at the same time.*

the thickness of the top slab to allow the large vise nuts to clear the underside of the benchtop.

Mounting the front-vise hardware and the large wood jaw is even more straightforward. First, the mounting bracket must be bolted to the underside of the benchtop. I used 5⁄16-in. lag screws. Next, the vise screw and guide bars are run through the bracket to locate their clearance holes in the front rail. Last, make the large wood jaw and bolt it to the vise hardware. Somewhere along the way, the front jaws for both vises must receive their large thumbnail profile, identical to the one on the trestle feet.

Once you have all of the hardware and vises in place, mill a 1⁄8-in. bevel on each of the outside jaws to accommodate flex in the hardware as the jaws tighten, which helps them maintain good clamping pressure at the top. Now you can attach the top to the base. Two lag bolts along the centerline of the bench are plenty for attaching the benchtop to the trestle base.

Flatten the top and finish the bench

Do the final flattening after the top has been mounted to the base and all of the vises are in place. If your glue-ups went well, all you will have to do is some scraping and sanding.

I didn't want a slick finish, as beautiful as it might be. Clamps, hold-downs, and vises depend on friction to hold parts securely. The traditional finish for a benchtop is linseed oil thinned with turpentine, which seals the wood enough to make glue removal from projects pretty easy but doesn't make the surface more slippery than it is naturally. However, I wiped on a thinned varnish for greater protection. To make sure moisture absorption is even on all sides, it's important to coat the top and underside of the bench equally. □

Lon Schleining makes furniture and staircases in Long Beach, Calif.



Attach the front-vise hardware to the front jaw. *Use the vise hardware to clamp the front jaw in its proper position before drilling for the attachment screws. Last, cut the half-blind dovetails on the left-hand end cap and attach it.*



Assemble the hardware for the twin-screw end vise. *Clips join the chain at the proper length. Again, use the vise hardware to clamp the jaw in position before drilling for the attachment screws.*



Under-Bench Tool Cabinet

Put this unused space to work

BY LON SCHLEINING

It's exasperating when I can't find a tool. Usually I know it's in a pile somewhere, or on a shelf, or over there where I think I saw it last …

Well, all that frustration is behind me now. After more than 27 years as a professional woodworker, I finally have a real tool chest.

This design fits under my workbench—the one featured on pp. 66-73—but you could easily adapt it to fit any size bench.

As with all of my projects, my first step was to draw the cabinet full scale in three different views, including all the construction details I could think of.

Two boxes are easier to build and move

I like the look of mitered corners and made that basic decision early on. Then I realized I wasn't very comfortable mitering an edge on a plywood panel nearly 4 ft. wide by only about 2 ft. long, so I decided to break the cabinet into two separate boxes. This makes the parts smaller and easier to handle, especially on the tablesaw. I also like the idea that if you have to break down your bench to move your shop, the two smaller boxes will be more manageable.

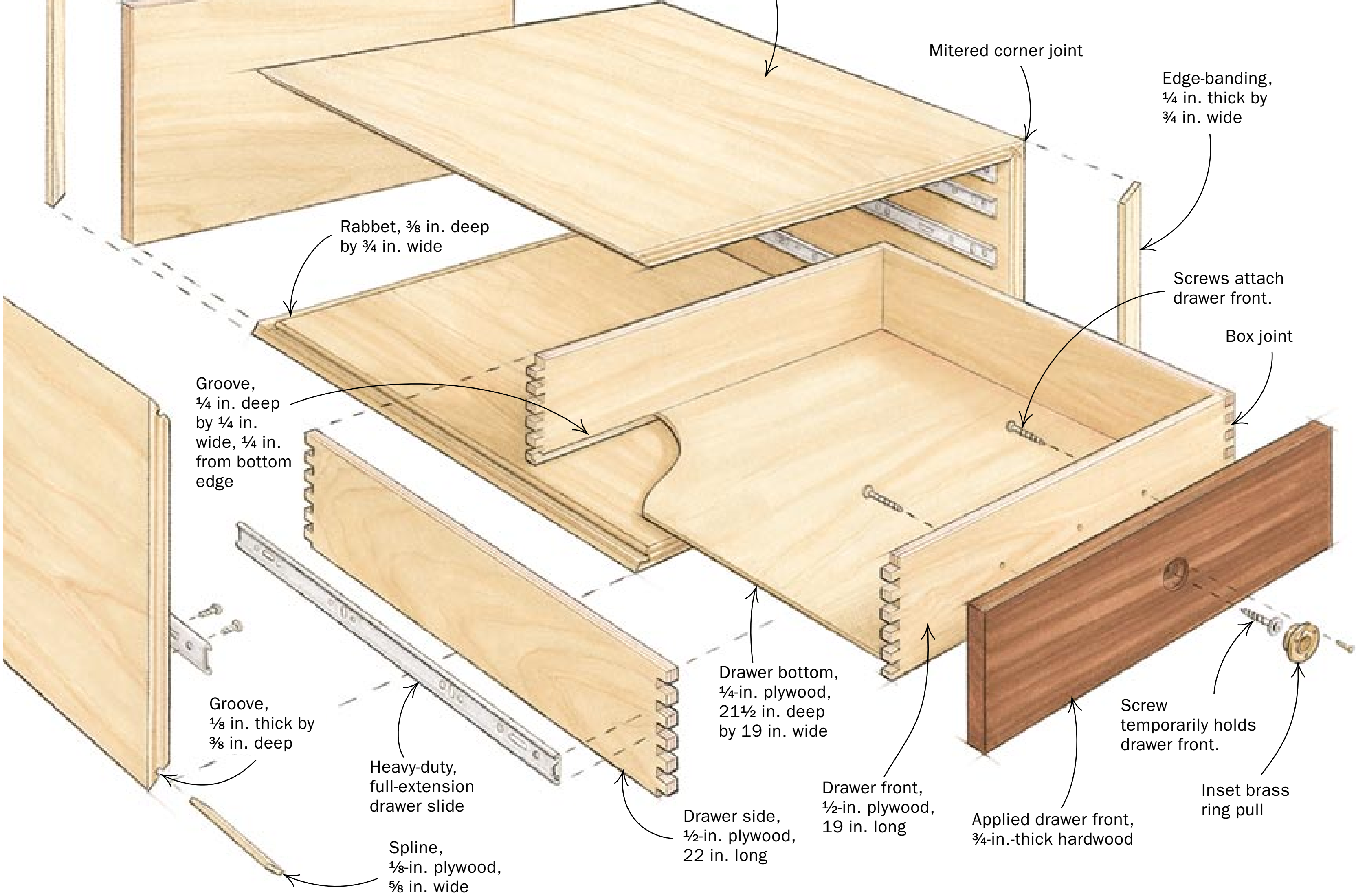
The workbench is made of maple, with walnut wedges in the trestle joinery. I like the visual contrast between these two woods, so for the cabinet, I chose maple plywood for the carcases and solid walnut for the drawer fronts.

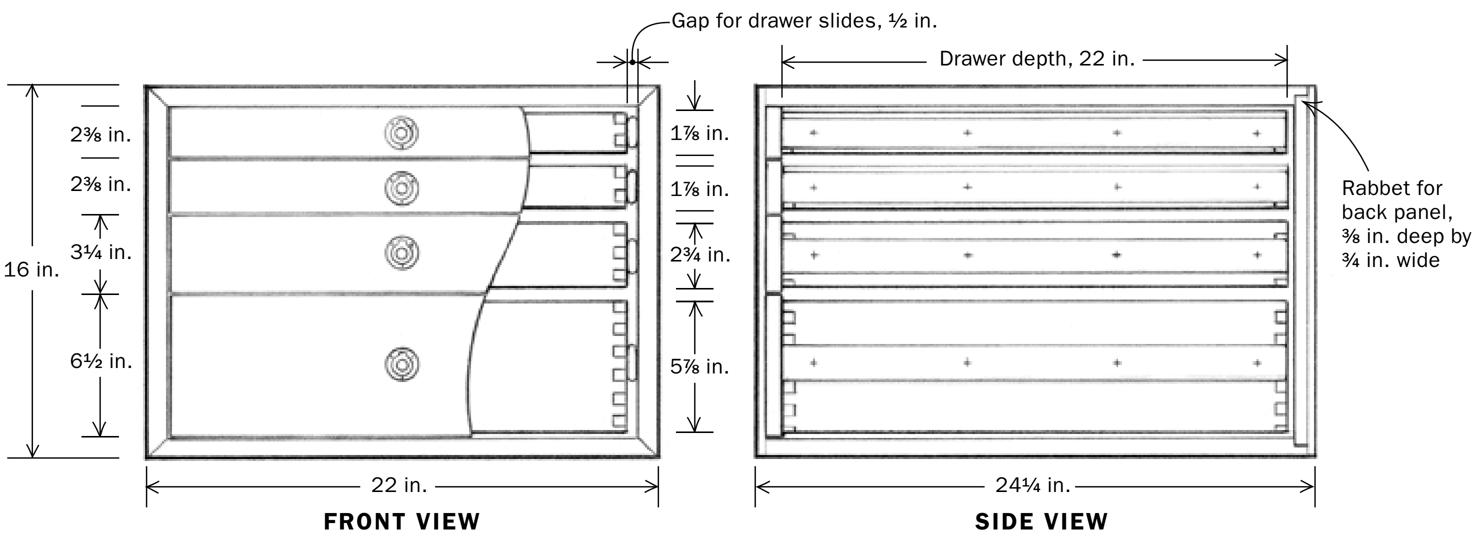
To make sure the carcases would stand up to heavy use, I splined the miter joints and glued a full ¾-in.-thick panel into a rabbet in the back of each carcase. On the

Photos: Asa Christiana; drawings: Bob La Pointe

TWO BOXES ARE BETTER THAN ONE

The fact that this is a shop cabinet influenced many of the construction choices. Two separate boxes are easier to make than one big one. Plywood cabinets are joined with miters and splines and dressed up with solid-wood edge-banding and drawer fronts. Plywood drawer boxes get quick box joints, applied fronts, and commercial slides.



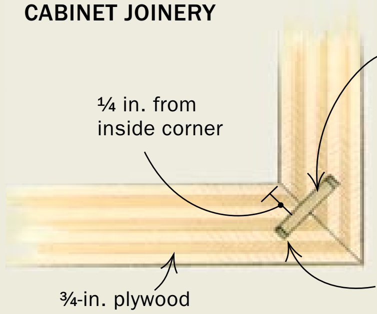


Cabinet boxes

MITERED PLYWOOD MAKES FOR QUICK CONSTRUCTION

The joinery is cut on the tablesaw, and packing tape draws the joints together tightly. For a utility cabinet like this, it is quicker to apply edge-banding after assembly.

CABINET JOINERY





Miter the edges of the panels. *Angle the sawblade just beyond 45° to ensure tight corners. Sneak up on the final width, and then cut the rest of the parts to size.*

front and back edges of each box, I glued solid edge-banding to cover the plywood edges and splines.

I measured the heights of the tools I wanted to keep in the cabinet and found I needed more small drawers than large ones. I standardized the drawer sizes as much as I could so that I could make several parts of the same size. I'm sure your tools differ from mine, so size the drawers accordingly.

One sheet of ¾-in. maple plywood is plenty for the carcases. I used three 5x5 sheets of Baltic-birch plywood for the drawers: one sheet ½ in. thick for the drawer sides and two sheets ¼ in. thick for the bottoms.

Heavy-duty, ball-bearing drawer slides offer smooth action and full extension, so they were an easy choice. I used Accuride 3832 slides rated at 100 lb., which should be plenty strong.

For the drawer pulls, I chose inset brass ring pulls, which match the brass benchdogs in my workbench and won't catch on power cords.

Miter and spline the cabinet parts

You might prefer to edge-band the plywood before cutting the miters and assembling the boxes, but I decided to do the edging afterward. This let me cut rabbets and spline slots all the way through on the tablesaw, because the front and back edges would be covered later. Also, the long miters had to be perfect only at their outermost edges.

First cut all the carcase pieces about 1 in. oversize, making sure the pieces are perfectly square. Next, mark the edges that get the miter cuts and rabbets.

Angle the tablesaw blade just a bit beyond 45° to ensure that the outside, visible edges will be tight. If you cut four small sample pieces, you can use tape to wrap them into a box to check your miter angles. Use very flat plywood for all of the cabinet parts; if it is bowed it might lift off the saw's table near the blade and the miters won't be accurate. Last, cut the rabbets for the backs.



Slot the edges for splines. *Angle the sawblade at exactly 45° and locate the grooves toward the fat corner of the edge.*

Splines reinforce the miters—I used ⅛-in. plywood for the spline material, as it fits loosely into a single blade kerf. A loose fit, with glue, is enough to provide some insurance for the miter joints. If the fit is too tight, the splines will bind when



Packing tape will be your clamps. *For these large boxes, it is easiest to tape up pairs of panels at a time. To close the joints, pull on the tape as you apply it.*



inserted in the already-assembled box (see photo, right). Angle the tablesaw blade at exactly 45° for the spline cuts. When ripping the spline material to width, leave plenty of clearance in the slots.

Packing tape is a great clamp

You will insert the splines from the front and back after the boxes have been taped up, so cut the spline stock into halves lengthwise. A benefit of inserting the splines this way is that they force the excess glue into the center of the joint instead of out the front and back.

I assemble mitered boxes with stranded packing tape. Normally, I lay down the pieces in a line, outside face up, and run continuous strips of tape across all four sides, leaving a 4-in. or 5-in. tab at the end. When glue is applied and the pieces are wrapped up into a box, the tape puts firm, equalized pressure at the joints. In this case, however, I found the pieces too large to handle all at once, so I taped two panels at a time and assembled the box from there.

While the glue is wet, insert the splines and the back panels, which will help square up the assemblies.

Edge-band the cases

Because you will apply the banding after these utility cabinets have been assembled, the easiest method is to make the edgebanding exactly as wide as the plywood



Two pairs of panels make a box. *After spreading glue on the miters, stand up the panel assemblies and draw the last two joints together with more tape (above). Apply glue to the spline stock and insert pieces roughly halfway into the joint (left), working from both ends. Nail and glue the back panel into its rabbet, and trim the splines flush.*

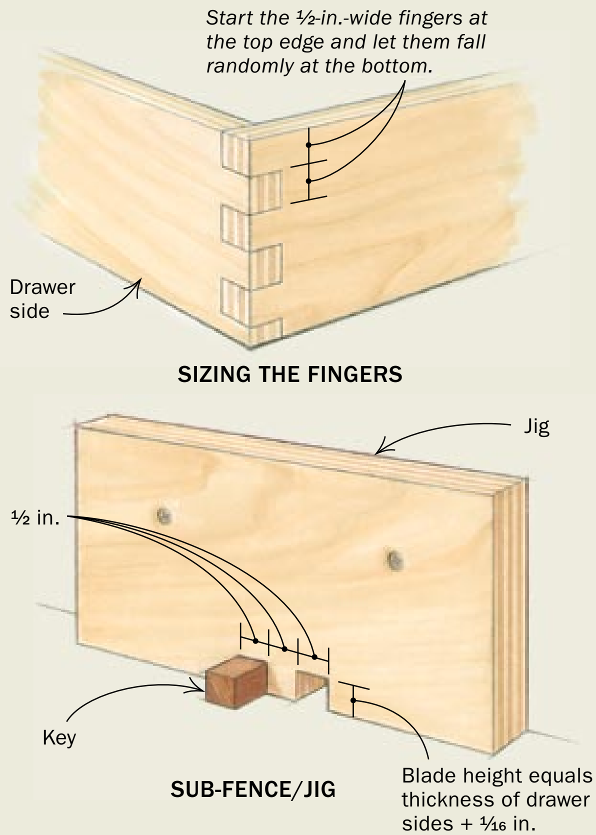


Apply thin banding cut to exact width, using your fingers to align it. *Dry-fit each piece first to fit the mitered ends. A 23-ga. micro-pinner leaves almost invisible holes.*

Drawer boxes

A LESSON IN BOX JOINTS

Made quickly on the tablesaw using a dado blade and crosscut jig, these finger joints create quick and sturdy drawer boxes. The drawer slides require an exact ½-in. gap on each side, so build a test drawer to dial in the final dimensions.





The ends of each piece are identical. *For the first cut, butt the top edge of the workpiece against the key.*

is thick. It's not hard to apply it perfectly aligned with the edges.

Use a planer to bring the banding down to its ¼-in. thickness. I used a nail gun to apply the edge-banding, using my fingertips to align it flush with the sides. A 23-ga. micro-pinner leaves almost invisible holes. Clamps or strips of masking tape can replace the nails, but you will need lots of them. Work your way around the edges of the cabinets, fitting and mitering each piece as you attach it.

Size the drawers carefully

In keeping with the practical nature of this project, I chose box-jointed (also called finger-jointed) drawer boxes with applied fronts. Box joints are strong, attractive, and easy to cut using a sled on the tablesaw.

The applied drawer fronts go on after the boxes are in place, making the fitting process much easier. In order for the drawer slides to work properly, it's important to have exactly ½ in. of space on either side of the drawer box. That's one reason to build the cabinet boxes first. Then, when cutting the drawer box joints, you must realize that raising or lowering the dado blade on the tablesaw will affect the size of the finished drawer box. Once you have set the blade height correctly, don't move it.

I run the box-joint fingers 1⁄16 in. extralong so that I can sand them flush after the drawer box is glued up. This means cutting the box parts ⅛ in. longer than I need them and carefully adjusting the blade height 1⁄16 in. above the thickness of the parts.

Install the drawer slides

Because these heavy-duty slides can be mounted anywhere on the drawer side, I was able to place them at the center and work from centerlines, which is my preference. After attaching the drawer slides to the drawer boxes, align and mount the other half of the slides inside the cases. To align the slides front to back, use a scrap of material equal to the thickness of the drawer fronts plus the recommended offset. To align the slides top to bottom, use a spacer panel placed under the slides, inside the cases, to be sure they are installed uniformly.

Initially, I installed the slides with only two screws. I got all the drawers installed and adjusted so that they worked properly, and then I inserted the rest of the screws.

Applied drawer fronts are easier to fit

Now comes the fun part: installing the solid-wood drawer fronts. The challenge is to have as fine and even a gap as possible around each drawer front, while allowing



Make the second cut. *To cut the second notch, just place the first notch on the key. The final notch on this drawer will be partial.*



Locating the mating side. *Flip the first side, put its first notch on the key, and clamp it. Butt the mating side against the first side (above). Cut the first notch on the mating side (right). The dado blade should just clear the first side.*



for some shrinking and swelling with changes in humidity. First, cut the drawer fronts to length and width so that they all fit together into the opening, with no gaps. With all of them in place, mark a centerline for the finger pulls, remove the fronts, and mortise for the pulls. All of the mortising is done easily on the drill press, with just a bit of chisel work afterward.

The mortises for these pulls allow a neat trick for attaching the fronts. Drill a clearance hole in the recess, through which you can loosely insert a pan-head screw. Now you can fit the drawer fronts one at a time, with the pan-head screws allowing some adjustment in all directions as you take light trimming cuts from the edges.

Once the fronts are in position, drive some screws into them from inside the drawer boxes to lock them in place. Then remove the pan-head screws and install the finger pulls.

Finishing up

For these cabinets I applied the same finish I used on the bench: a few coats of varnish thinned about 50% with turpentine, applied with a rag and rubbed off before it dried. Last, I added a few thin cleats to the bottoms of the boxes, to keep them in place on the lower stretchers of the workbench.

Now everything is in its place. Sure, I can't remember which drawer my mortising chisel is in, but I know it's in there somewhere. □

Lon Schleining makes furniture and staircases in Long Beach, Calif.

INSTALL THE DRAWERS

The drawer fronts are fit and applied after the slides and boxes are in place, making it easier to achieve fine, uniform gaps and a neat appearance.

HARDWARE SOURCES

FULL-EXTENSION BOX DRAWER SLIDE

Accuride Series 3832
www.rockler.com

1½-IN.-DIA. RING PULL

www.antiquehardware.com
www.leevalley.com



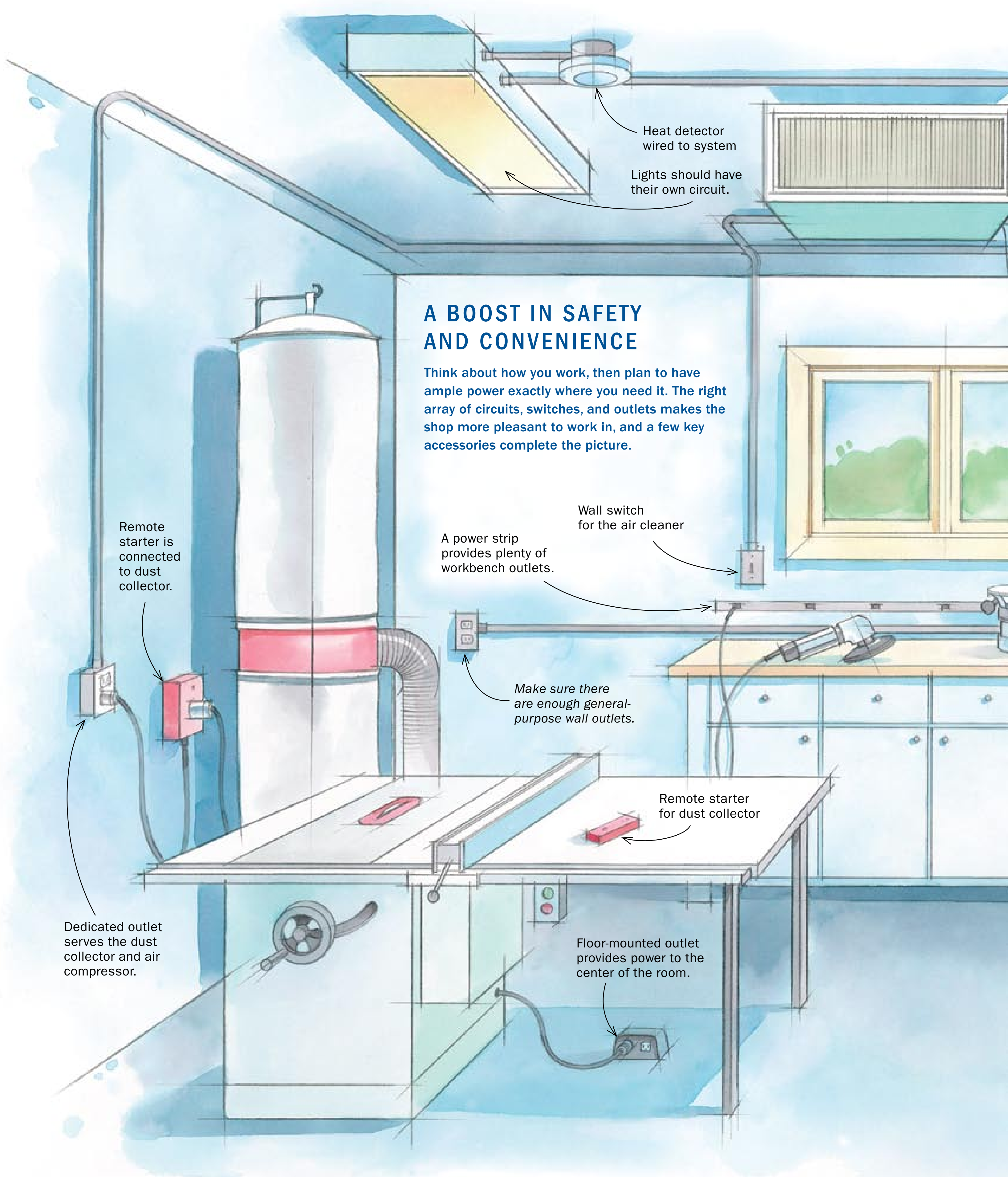
A trick for installing slides. *Working off the centerlines of the drawers and slides, Schleining uses a spacer panel to set the distance between the slides and the cabinet bottom. A small block sets the distance from the front edge.*



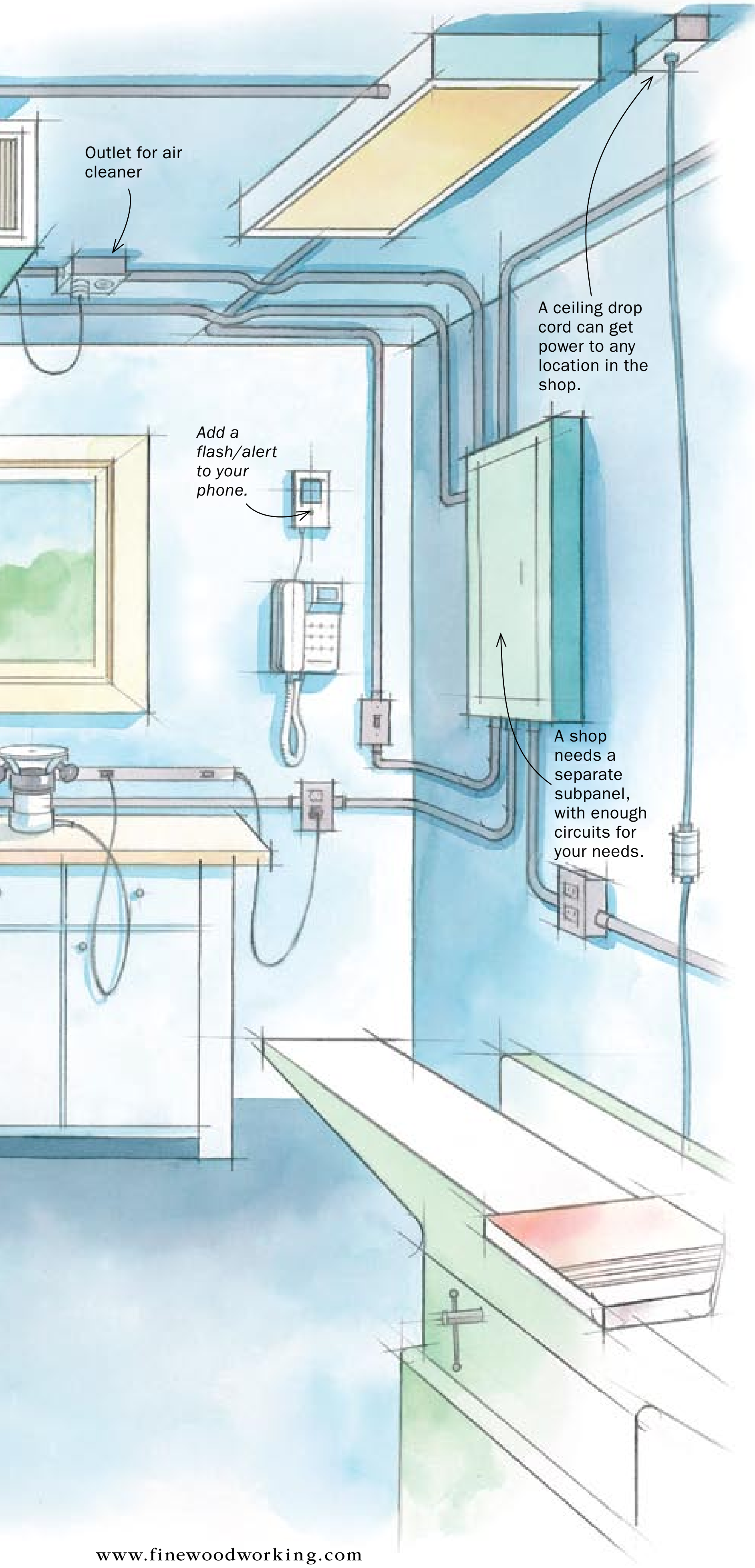
Fit and attach the drawer fronts. *Drill a slightly oversize hole in the round mortise for a pan-head screw. Use credit cards to set the gaps, and use the screw to lock the drawer front in place. Then screw the front permanently from the inside, remove the temporary screw, and install the pull.*

A BOOST IN SAFETY AND CONVENIENCE

Think about how you work, then plan to have ample power exactly where you need it. The right array of circuits, switches, and outlets makes the shop more pleasant to work in, and a few key accessories complete the picture.



Drawings: Brian Jensen



Wiring Your Workshop

Make a smart plan, and you'll know what to tell the electrician

BY CLIFFORD A. POPEJOY

The electrical wiring, outlets, and lighting in your shop should be as specialized as your tools. It's hard to turn out high-quality work—or to work safely—in a poorly illuminated shop. It is equally frustrating and potentially dangerous if your tools keep tripping breakers on underpowered circuits or if your floor is a tangle of extension cords. To upgrade your workspace to meet the special needs of woodworking, you should know how to identify your needs and then communicate them to an electrician with the skills to turn your plan into reality. If you put these ideas to use, your work time in your shop will be safer and more satisfying.

Shop features dictate the wiring layout

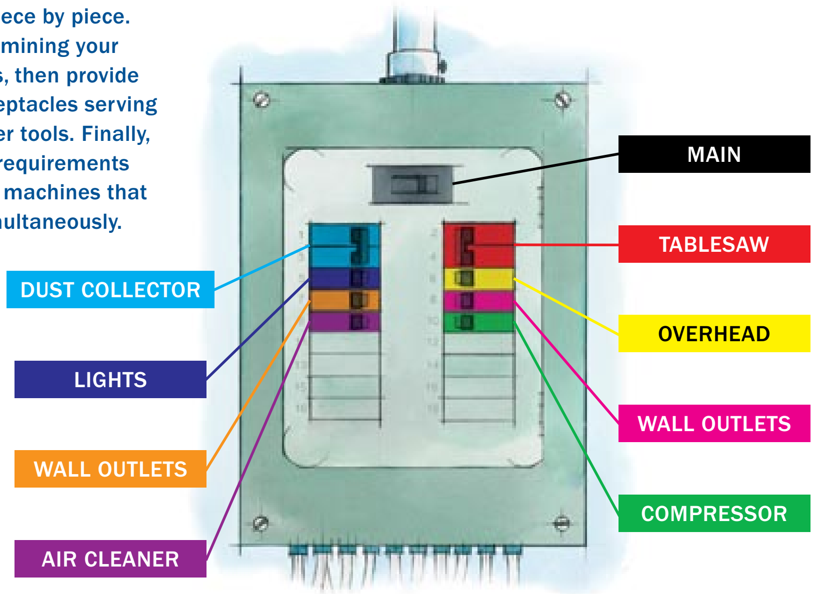
Installing the wiring for a woodshop is done most easily during construction or remodeling with the walls open, but it can be done anytime. If the walls are closed in, either have the wiring run in surface-mounted conduit or hire an "old work" electrician who can run wires in existing walls and make a minimum of holes to be patched later.

To feed the shop circuits, the best approach is to install an electrical subpanel (breaker box) specifically for the shop. In a well-designed system a breaker will rarely trip, but if it does, it helps to have the panel nearby.

There's a wide range of subpanels available, and your choice will depend on how much power and

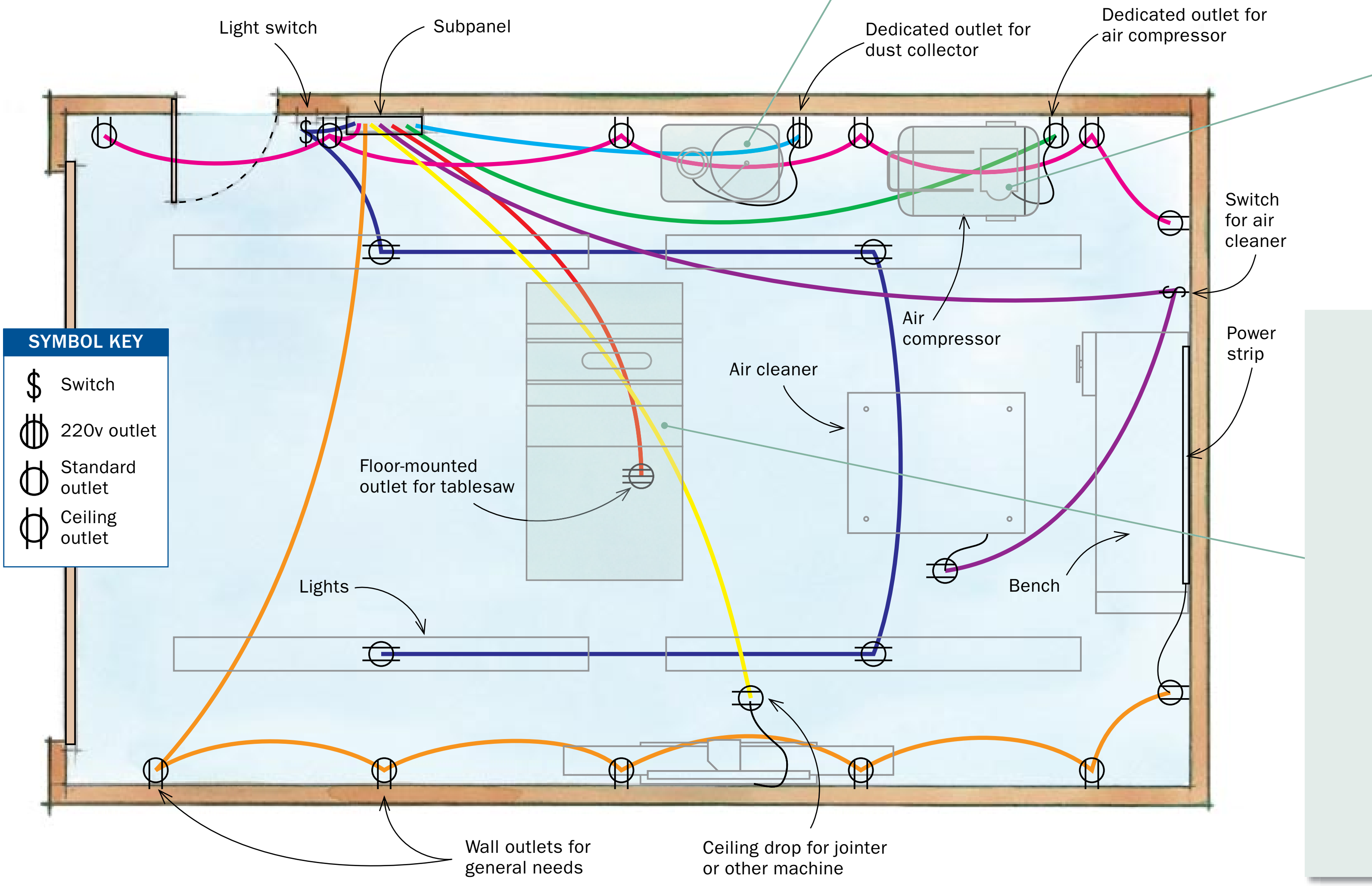
Plan circuit by circuit

Designing the wiring for your shop is pretty simple if you approach it piece by piece. Start by determining your lighting needs, then provide power for receptacles serving portable power tools. Finally, work out the requirements for stationary machines that might run simultaneously.





Dust collector needs dedicated power. *Check the voltage that the dust collector motor runs on, and wire a separate circuit for it.*



Photos: Staff

how many circuits you need. At any given time, most one-person shops will be running one major stationary tool, a dust collector, an air-filtration system, and lights. In this case, 60 amps at 240/120v likely will provide enough power. If there's heating or air conditioning running as well, a 100-amp subpanel probably will be adequate. I suggest a panel with room for 16 or 20 circuit breakers. These are starting points. Because each shop is different, you should calculate the number of circuits and power needs of your own.



Consider a separate circuit for the compressor. *By running your air compressor on its own circuit, you avoid the possibility that it will trip a circuit breaker when another tool is used.*

There are two interdependent aspects to wiring a shop. One is circuit design—how the various things that use power (called "loads") are arranged and grouped, and how they are connected to their electricity source through wiring and circuit breakers. The other is the choice and location of light fixtures, receptacles, and switches.

Let there be light (on its own circuit)

Depending on the size of the shop, you should have one or more 120v, 15-amp circuits dedicated to lighting. That way if you are ripping a board and your tablesaw trips a breaker, you won't be plunged into darkness and into a dangerous situation.

To compute how many lighting circuits you will need, add up the total wattage of the lights and provide one 15-amp lighting circuit for every 1,500 watts. This is based on loading each circuit to about 80% of its capacity. This cushion, though not required in noncommercial applications, is still a good idea.

For example, to provide lighting for a single-car garage-size shop (240 sq. ft.) with 96-in., high-output (HO) fluorescent lights, you would need four separate two-lamp fixtures. Each 8-ft. lamp requires 110 watts, so you would need a total of 880 watts to light this shop. Consider installing some task lighting (say a track fixture with three, 65-watt floodlamps or equivalent fluorescent floods) as well. I'd put this lighting on one 15-amp circuit.

Consider setting up the lighting so that the general lighting fixtures are wired to two or more separate switches, with the task lights switched separately from the general lighting. This way, if your machine and bench areas are separate, you can save energy by illuminating only the area in which you're working. (For more on shop lights, see "Lighting for the Workshop," pp. 86-91.)



Cabinet saws have special needs. *Create a separate 220v circuit, and run it to a floor outlet in the center of the shop.*

Outlets: the more the better

It's a fact that a shop can never have too many clamps, and it's equally true that it can't have too many receptacles. Receptacles should go on 20-amp circuits. There's no limit set by the National Electrical Code (NEC) for the number of outlets that can go on a circuit in a residential application. For a shop, it makes sense to identify the loads you expect to operate at the same time and group the receptacles onto circuits so that each circuit can comfortably support the expected demand. A 120v, 20-amp circuit can provide 2,400 watts, although it's a good idea to keep the load to 80% or less, or about 1,900 watts. To figure out how many circuits are needed, look at the power needed as shown on the tool nameplate (some nameplates will specify watts, and some amps). If the tool specs give amps only, convert from amps to watts for a 120v tool by multiplying amps times 120. For instance, if you have a small air compressor that draws 13 amps (1,560 watts), put in a receptacle supplied by its own 20-amp circuit, called a "dedicated" circuit. For outlets that won't be supplying a specific tool, as in an area like an assembly bench where you will be using various small power tools, I suggest three or four outlets on a 20-amp circuit.

The NEC requires ground-fault circuit interrupter (GFCI) protection for any 15-amp or 20-amp branch circuits supplying a garage or other work area at grade level. You can meet this requirement by using a GFCI circuit breaker or by having a GFCI receptacle first in line and wired to protect the downstream receptacles.

For general-use outlets, like the ones used for routers, hand sanders, and corded drills, it is a good idea to set up circuits based on the area served. For example, you might set up a separate circuit for each

Get the power where you need it



CEILING

One way to avoid having power cords strewn about your shop floor is to use a ceiling-mounted drop cord. This brings power to the middle of your shop in a convenient and safe way. Just roll out the tool of choice and plug away.

FLOOR



Another way to bring power to the center of your shop is to use a monument-style receptacle. This type avoids the problems of a flush-mounted receptacle, which include dust clogging and possible shorts from metal objects.



***Workbench power.** A Plugmold power strip gives you a convenient place to plug in power tools that are used often at your workbench.*

wall. Or you may want a couple of 20-amp circuits to serve your workbench, where you might have three or four outlets on each circuit. A neat trick is to run two circuits along the wall and feed alternating receptacles from the two different circuits. Don't use a shared neutral circuit for this; you have to GFCI-protect the outlets, and keeping the two circuits completely separate makes this easier.

A product called Plugmold (www.wiremold.com) is useful for providing workbench power. It is a steel channel with outlets spaced at intervals. Plugmold stands about 1¼ in. wide and above the surface and is available in various receptacle spacings (12 in. is best for shop use). Plugmold is much sturdier than a typical cord-connected "power strip" and is the right way to pack a lot of outlets along a wall.

It's a good idea to place wall outlets 50 in. above the floor (to the bottom of the box). That way if you lean sheet goods against the wall, they won't cover the outlets. And the outlets will be well above any benchtop or other work surface. Another nice setup is to set aside a shelf area for cordless-tool chargers, and put a 3-plus-ft. strip of Plugmold with 6-in. receptacle spacing on the wall behind the shelf. Put this on a separate 20-amp circuit, so you can leave it powered up while turning the other receptacle circuits off at the breakers for safety when you're not in the shop.

Get plenty of juice to stationary tools

The big guns—stationary tablesaw, jointer, planer, dust collector—draw so much power that they each require their own circuit. (Without it, running two simultaneously will trip a breaker.) If the motor can be set up to run on 240v, have an electrician do it. It will probably require taking the motor out of the machine. There's no power efficiency advantage to running a machine at 240v vs. 120v in a single-phase system, but the higher voltage means lower amperage, and as a result, you can use smaller-gauge power-supply wiring. That translates into less expense to run the wire and to hook it up.

To figure out what size circuits you will need, check the amp rating on each tool's data plate or in its product manual. Keep in mind that the circuit breaker at the subpanel is designed to protect the building's wiring from an overcurrent condition—it does not, however, ensure that the machine's motor won't overload. If the motor does not have an internal circuit breaker for overload protection (the tool manual

will indicate this), a fused disconnect may be required. Ask the electrician to install it. The fuses in the disconnect box will protect the motor windings from overheating.

Some tools are an island—Getting power to a machine in the middle of the floor can be a challenge. You don't want a cord running along the floor that you might trip over. If there's a basement or crawlspace below, I would run cable or conduit below the floor and use a monument-style housing to hold the receptacle at the base of the machine (see bottom left photo, facing page). A flush-mounted floor outlet is a poor choice for a shop. It will fill with debris and could be shorted out by a stray nail or staple.

If you plan to move shop machines around and you want to keep the floor clear, use a hanging (pendant) outlet about 6 ft. to 7 ft. above the floor. To prevent accidental unplugging, a locking cord cap on the receptacle end of the pendant outlet is a good idea (see top left photo, facing page). This will require you to put a compatible locking plug on the machine cord, or make an adapter.

Custom touches add safety, convenience

Even though they are full of flammable materials, most woodshops have no smoke alarms. That is because airborne sawdust can set off the photo-ionization or photoelectric sensors typically used in smoke alarms to detect smoke. The solution is to install a heat-detecting fire alarm that can activate the smoke alarms in the house. Firex (www.icca.invensys.com/firex) has a complete line of smoke alarms that includes compatible heat-detector units.

It's nice to have a phone in the shop, but how do you hear it ring while planing boards and wearing hearing protectors? You can add a flashing visual alert.

Another convenience is to have your dust collector start automatically when you switch on a machine it serves. Ecogate (www.ecogate.com) sells a system that not only turns on the dust collector when it senses that a tool has started, but also opens and closes the adjacent blast gate. Alternatively, you could install a relay and receiver on the dust collector's cord that switches on and off with a remote-control transmitter that can sit in a convenient spot or hang on your key ring (like a car-door remote).

Consider these useful accessories

HEAT DETECTOR



Airborne wood dust can cause false alarms with a standard smoke detector. A heat detector can warn you of a shop fire and can be wired into your home fire-detection system if the shop is in a detached building.

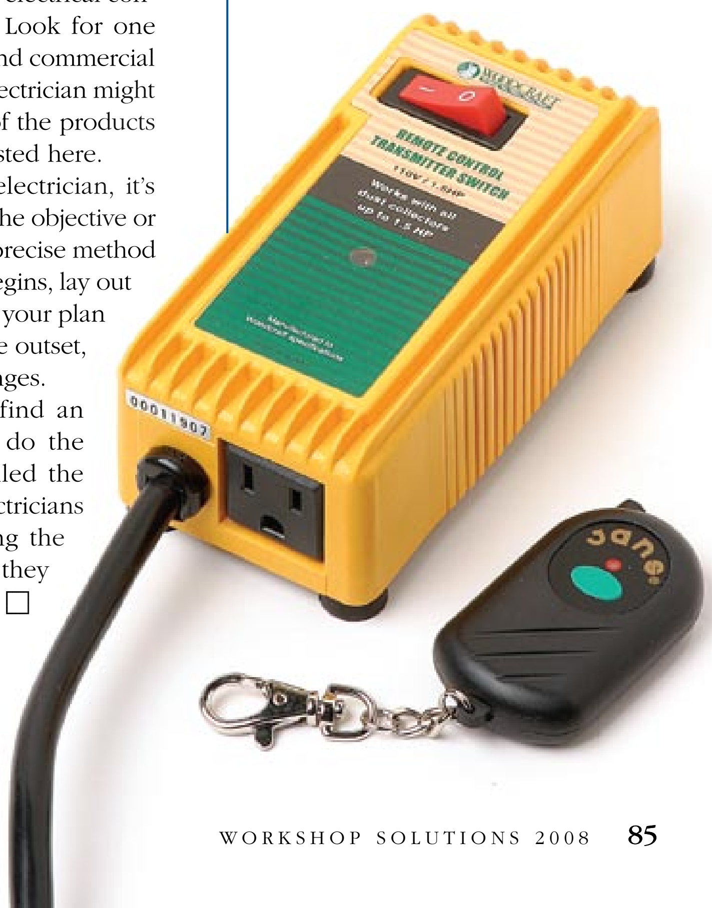
TELEPHONE FLASHER



If your shop has a telephone, it will be impossible to hear when you are wearing earplugs and operating loud machinery. This device uses a flashing light to let you know that you have a call.

REMOTE-CONTROL TRANSMITTER SWITCH

A remote-control receiver is connected between the dust collector's power cord and the receptacle. A small transmitter lets you turn the collector on and off from anywhere in the shop. This will save you a few steps and let you devote more attention to your work.



Work with your electrician

Unless you're a qualified electrician or are willing to take the time to become familiar with the techniques of the trade, the many requirements of the NEC, and any local codes pertinent to shop wiring, you should find a licensed electrician or electrical contractor to wire your shop. Look for one who does both residential and commercial work; a strictly residential electrician might not be familiar with some of the products and design elements suggested here.

When working with an electrician, it's more productive to explain the objective or goal than to try to dictate a precise method or approach. Before work begins, lay out your requirements clearly. If your plan and goals are not clear at the outset, be prepared to pay for changes.

Finally, don't expect to find an electrician who will "just do the hookups" after you've pulled the wires, etc. Few licensed electricians will take the risk of putting the finishing touches on work they didn't do themselves. ☐

Clifford A. Popejoy is a licensed electrical contractor and occasional woodworker in Sacramento, Calif.



Light Up Your Workspace

Choose the right fixtures and locate them for bright, even coverage

BY JACK L. LINDSEY

The owner of a small shop can seldom justify the services of a lighting design professional. So the task of lighting a shop is usually accomplished by putting up a few fixtures and, if that doesn't work, adding a few more. Sometimes this works, but learning some of the basics about lighting will produce better results faster and more economically in the long run. The most common mistakes are using the wrong type of lamp or fixture, installing too few fixtures, and putting fixtures in the wrong locations.

Photos, except where noted: Erika Marks; this page: William Duckworth



The first step in lighting a shop is to decide what strategy to use: to light the whole shop in a reasonably uniform manner or to concentrate light at machines and work areas.

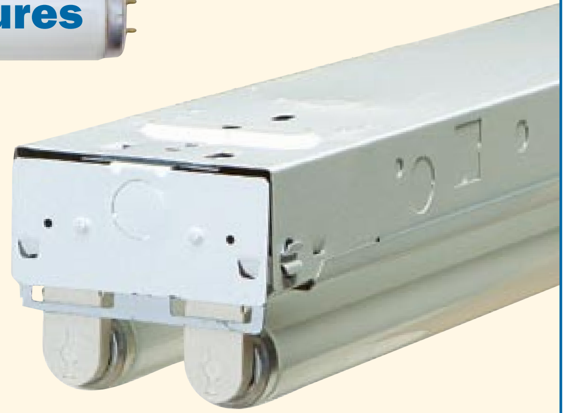
For small shops, I recommend uniform lighting because it allows you the freedom to change the location of machines and workstations within the shop. It also means you can install fluorescent fixtures in continuous rows. This reduces the cost of electrical wiring by allowing you to run wires through the fixtures instead of

Fluorescent fixtures

Two basic types of fluorescent fixtures, called strips or industrials, are commonly used for shop lighting. Strip fixtures are simply metal channels fitted with lamp holders and ballasts. For really tight spaces, you can use a low-profile strip fixture with lamps mounted on the sides of the fixture instead of the bottom. Industrial fixtures are equipped with a white metal reflector mounted above the lamps.

Strips should be used when fixtures are mounted directly to a finished ceiling that has been painted flat white. Industrials work better when the ceiling is not flat, not painted white, or when fixtures must be suspended below the ceiling.

Industrial fixtures are available in two types—apertured and nonapertured. Apertured fixtures have a series of holes in the reflector that allow air to pass through, which helps keep lamp and fixture surfaces clean. Also, air circulation cools the ballast, thus extending its working lifetime. A ballast in an apertured fixture can easily last twice as long as one in a nonapertured fixture.



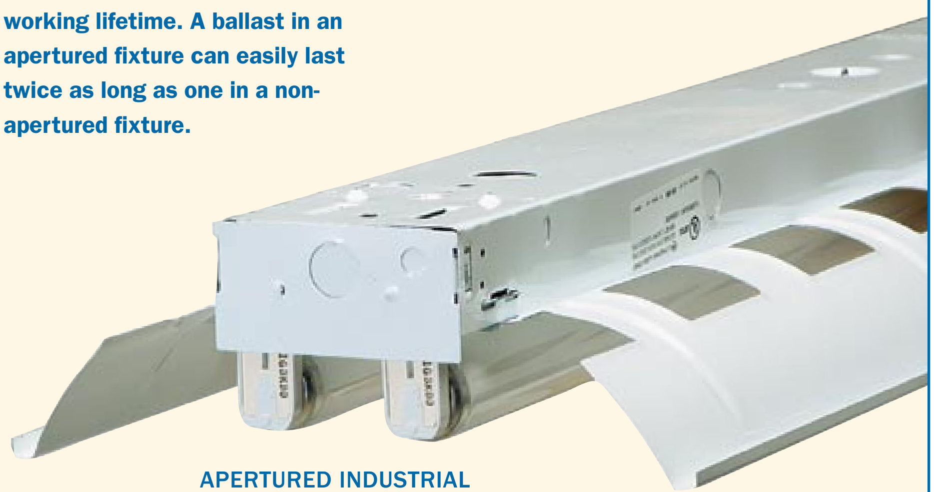
STANDARD STRIP



SIDE-MOUNT STRIP



NONAPERTURED INDUSTRIAL



APERTURED INDUSTRIAL

PLACEMENT

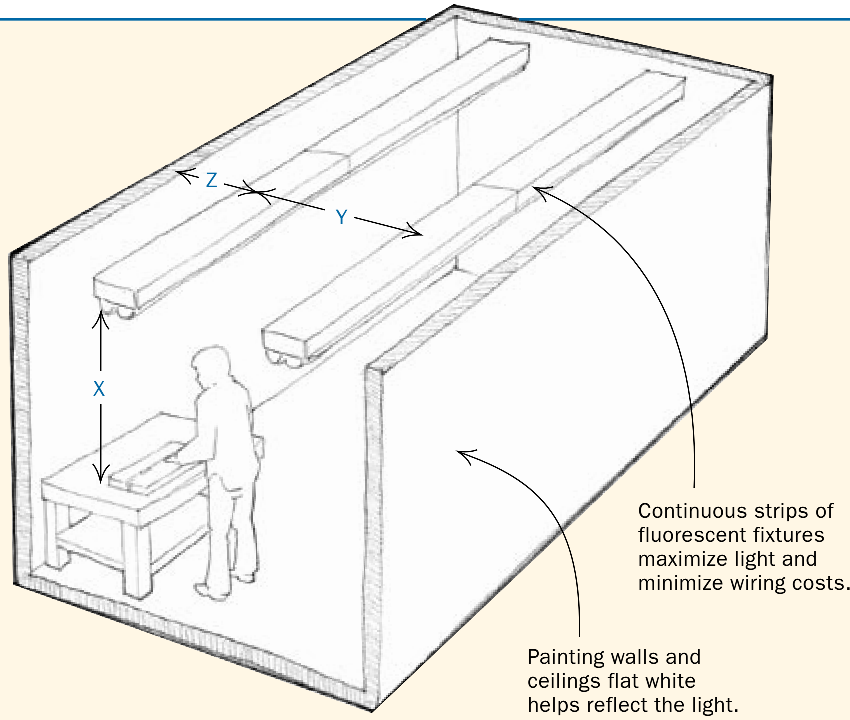
The older you are and the more detailed the work you do, the more light you need. Concentrated spot or task lighting works, but a uniformly lit space, like the one shown at right, will allow you more flexibility and improve your working environment.

Here are the steps for determining the placement of light fixtures:

1. Measure the distance between the light source and the horizontal work surface (X).

2. The distance between rows of fixtures (Y) should be a maximum of 1½ times the distance X.

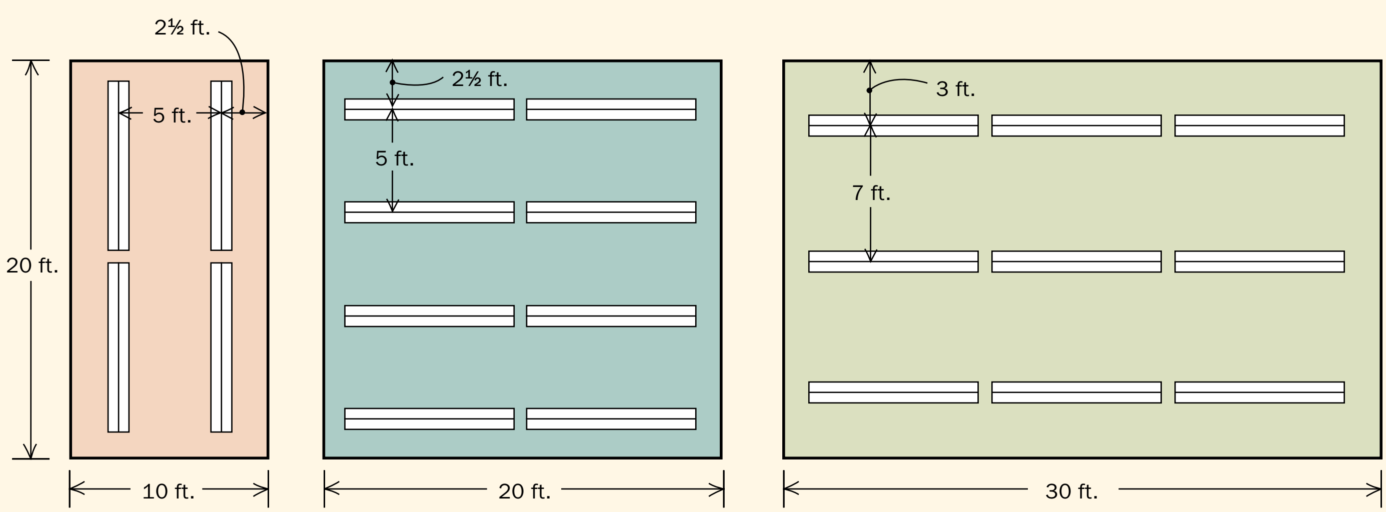
3. The distance between a wall and a row of fixtures (Z) should be approximately a third to half the distance Y.



CALCULATING HOW MANY YOU NEED

Here is a breakdown of how many two-lamp, 8-ft. fluorescent fixtures you will need to light a workshop uniformly to 100 fc of light. For 4-ft. fixtures, just double the numbers in the chart. Consult a qualified electrician to determine the size and number of circuits required to power your lighting needs.

ROOM SIZE	60 WATT	75 WATT	110 WATT
10 ft. by 20 ft.	5	4	3
20 ft. by 20 ft.	8	8	5
20 ft. by 30 ft.	12	9	8
30 ft. by 30 ft.	17	13	11
30 ft. by 50 ft.	29	23	19



Drawings: Erika Marks

installing a separate feed to each fixture. If you take this approach, wires are run within 3 in. of the ballast, so you must use wire that is rated for 90°C.

How many fixtures do you need?

How much light you need depends on the visual difficulty of the work you do and how well your eyes function. Eyesight deteriorates with age, so we need more light as we grow older. Lighting levels are described by a unit of measure called the footcandle (fc). A woodshop should be lit uniformly to a level of 50 fc to 100 fc. You can provide higher levels, if needed, with a separate fixture. Plan for 50 fc if the average worker is younger than 40 and doesn't do much work that is difficult to see, such as small, intricate shapes or dark colors. For workers who are older than 40 or who do work that is difficult to see, plan for 100 fc.

As light leaves a fixture and travels to your workbench, it spreads out. You get higher lighting levels near the fixture, with those levels dropping rapidly as the distance from the fixture increases. Because of the diminishing levels of light, you need to limit the spacing between fixtures to avoid dark spots. To figure the maximum spacing between fixtures, you need to know the type of fixtures and the horizontal plane in which visual tasks are performed—for most shops that means the top of the workbench, which is 2½ ft. to 3 ft. off the floor.

For example, if fixtures are mounted 10 ft. above the floor and the workbench height is 3 ft., the distance between the fixtures and the workbench is 7 ft. Typical strip fixtures should have a maximum spacing of 1.6 times that distance, or 11.2 ft. Industrial fixtures should not be spaced more than 1.5 times the distance, or 10.5 ft., for that workspace. Changing the fixture-mounting height or the work-plane height will change the maximum spacing. Please note that this recommended spacing is not the optimum; it is the maximum. Closer spacing is usually required to achieve desired lighting levels. And remember, walls and ceilings should be painted with a flat white paint whenever possible to reflect light more uniformly around the shop.

Another general rule will help to avoid dark shadows where you least want them: The distance from the wall to a row of fixtures should be one-third to one-half the distance between rows of fixtures, because we often locate equipment and workbenches along walls. See the drawings and the chart on the facing page for more on determining how many fixtures you'll need for a workspace and where to put them. The calculated number of fixtures is seldom a perfect match to the layout of a space, so some juggling may be necessary to fit the fixtures into the room. Don't be afraid to look at alternate layouts before settling on a plan.

Shedding some light on lamps

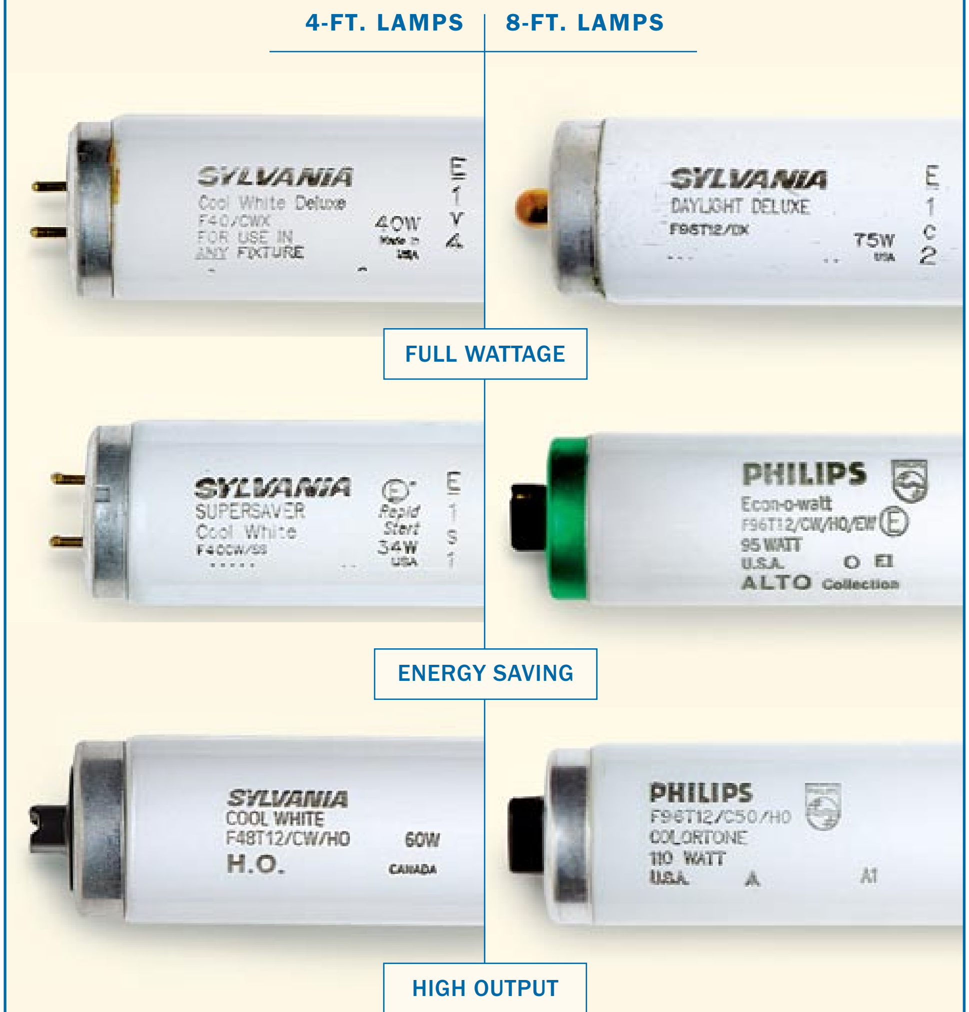
Fluorescent lamps (shown above) are best for lighting small shops. The two most

LAMPS

The variety of fluorescent lamps can make the uninitiated consumer dizzy. Full-wattage 8-ft. slimline lamps are rated for 75 watts, and the 4-ft. F40s for 40 watts. Their energy-saving counterparts (with such names as Watt-miser, Supersaver, and Econ-o-watt) are rated at 60 watts and 34 watts, respectively. Full-wattage high-output 8-ft. lamps are 110 watts; the 4-ft. versions are 60 watts. To complicate matters more, T12 lamps come with three different styles of bases that must be fitted to matching fixtures. In the near future, look for the smaller, energy efficient T8 lamps to become more common.



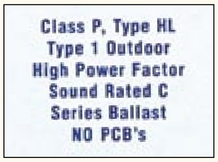
Match the lamp base to the fixture. *Fluorescent lamps in all sizes come with a variety of bases to choose from (clockwise from the top): two-pin, single pin, and recessed double contact.*



BALLASTS

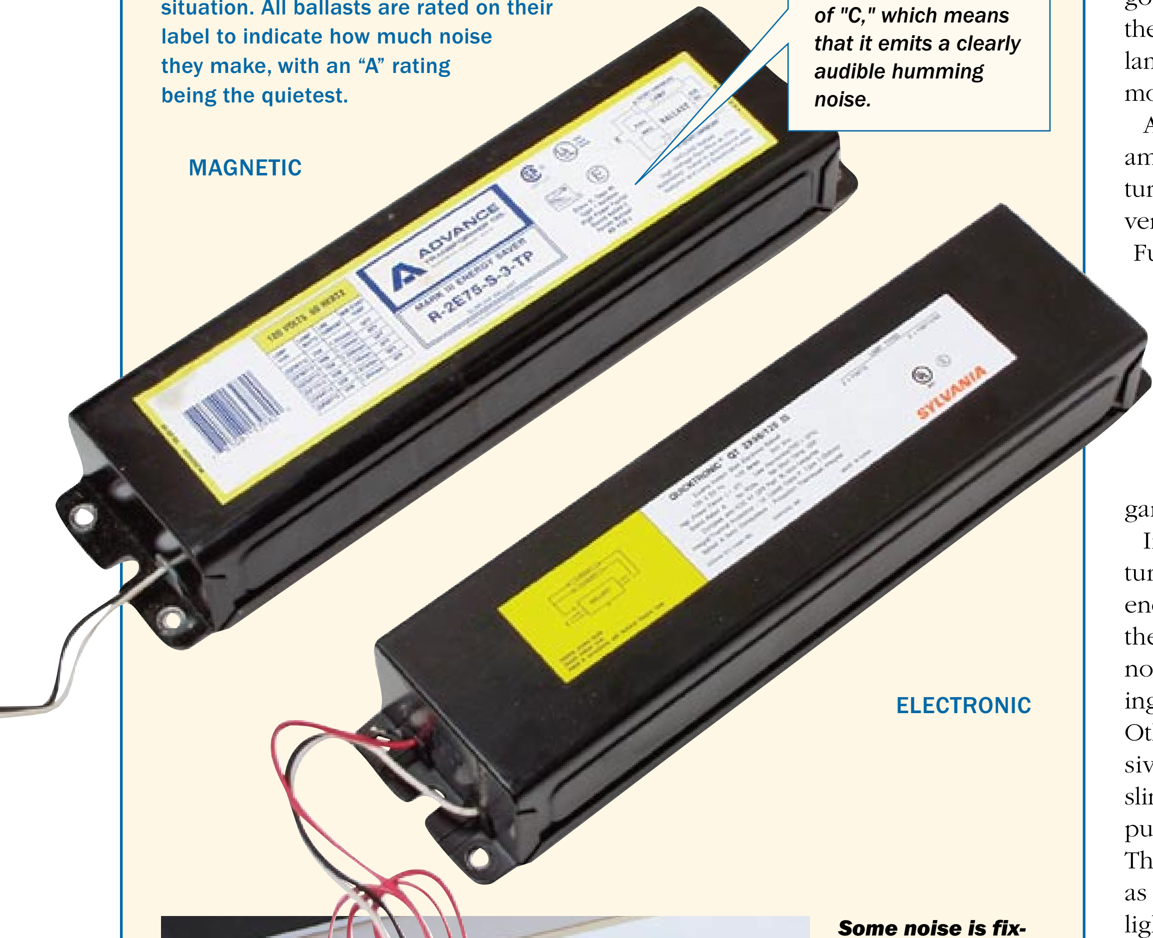
The ballast regulates the voltage through the lamp. Magnetic ballasts used to be the norm. But they fail to meet standards of the 2005 National Energy Policy Act and so they will be phased out over the next few years, replaced by the more efficient electronic ballasts. With either type, choose a commercial-grade product. Be certain that the specifications on the ballast match the size and number of the lamps you want to use in the fixture and that the ballast has the right starting temperature for your situation. All ballasts are rated on their label to indicate how much noise they make, with an "A" rating being the quietest.

RATING NOISE



The label shown indicates a sound rating of "C," which means that it emits a clearly audible humming noise.

MAGNETIC



ELECTRONIC



Some noise is fixable. *Most ballasts slip into a tab on one end and are fastened with a sheet-metal screw into the fixture on the other end. A loose fit at either location can cause noisy vibrations. Bend the tab or tighten the screw to cure the problem.*

common lamps for shop use are the T12 and T8 types. The number designations describe the diameter of the lamps in eighths of an inch. For instance, T12 lamps are 1½ in. dia., and the T8s are 1 in. dia.

The 8-ft. slimline lamp and the 4-ft. F40 have been the workhorses in many shops for years. Both of these are T12 lamps. However, due to changes in the National Energy Policy Act, T12 lamps will be phased out over time because they don't meet energy efficiency standards. If you are installing new lights, it makes sense to go with the smaller T8 lamps, which meet the new standards. As time goes by, these lamps and fixtures will become more commonly available, even in 8-ft. lengths.

All fluorescent lamps are sensitive to ambient temperature, especially when first turned on, and most are produced in two versions—full wattage and energy saving. Full-wattage lamps start reliably at 50°F or higher when operated on standard ballasts, and 0°F when operated on low-temperature ballasts. Full-wattage high-output lamps will start as low as -20°F on standard ballasts. Energy-saving lamps are rated to start at temperatures of 60°F or higher regardless of the ballast type.

In moderate climates, where temperatures at ceiling level are 60°F or higher, energy-saving lamps are preferred because they're cheaper. But if temperatures are normally lower than that, consider heating the shop before turning on the lights. Otherwise, you'll have to use the expensive full-wattage, high-color rendering slimline lamps, cold-temperature high-output lamps, or cold-temperature 4-ft. F40s. The drawback to 4-ft. lamps is that twice as many lamps and fixtures are required to light the space, which increases the labor required to install the system.

Lamps are rated for color—When choosing a fluorescent lamp, pay attention to the color rating, or temperature. This will tell you how closely illuminated items will match their color in pure daylight. Lamps with a low color temperature (around 3,000) impart a warm, red-yellow-orange appearance; a medium-range temperature (3,500) will have a neutral, or balanced, color rendering; a high-range temperature (4,100) will have a cooler, blue-white color rendering.

Cool white lamps have a fair color rendering. If you choose full-wattage slimline lamps, consider the high-color-rendering

Photos, facing page: William Duckworth

type. GE calls these lamps SP, Osram-Sylvania uses the Designer designation, and Philips calls them Ultralume. Full-wattage deluxe color lamps (such as Cool White Deluxe) are cheaper than high-color-rendering lamps, but they are 25% to 33% less efficient. If color matching is important in your work, you can buy special Chroma 50 lamps made specifically for this task.

Weighing in on ballasts

Unlike incandescent fixtures, which create light by heating a filament inside the bulb, fluorescent lamps work by exciting gases inside the bulb. The electric charge causes the gas to emit invisible ultraviolet light that reflects off a white coating in the bulb, which in turn creates visible light. Unchecked, this reaction to the electricity will cause the light to increase in intensity until the bulb no longer works.

Enter the ballast. This device provides the high voltage needed to start the lamp and then regulates the voltage so that the correct amount of light is emitted from the lamp. Ballasts are either magnetic or electronic.

Magnetic ballasts are on the way out—Magnetic ballasts used in fixtures designed for commercial and upper-end residential applications are commercial-grade, transformer types. The commercial versions drive lamps at about 95% of their rated light output. They also contain a capacitor to reduce the amount of current drawn by the ballast and can be identified by their larger size and the letters CBM (certified ballast manufacturer) inside a diamond shape on the label. Residential-grade ballasts, on the other hand, produce lower light output, shorten lamp life, and draw more current—all good reasons not to use them.



Let there be light where it's needed. *Even though Lindsey chose a uniform approach to lighting his own shop, he had to fill in some areas with task lighting.*

Magnetic ballasts hum. The bigger the lamp, the more noise the ballast will make. Some hum more than others, and cold temperatures exacerbate the problem. Although ballasts can be very noisy when started in a cold shop, they should be significantly quieter after they warm up. If you hear excessive noise from one or more fixtures, the cause may be a loose mechanical connection between the ballast and the fixture. Most ballasts are installed with one end slipped into mounting tabs and a screw securing the other end. Make sure the tabs and the screw are tight; if not, tighten the connection. If you still find that one ballast is much noisier than the others, replace it. And if the low-level hum typical of fluorescent fixtures in a normal operating mode annoys you, consider masking the noise with a fan, a dust filter, or a radio.

Magnetic ballasts used to be the most common on fluorescent fixtures. They were affordable and reliable. However, the National Energy Policy Act of 2005 targeted many magnetic ballasts as being too inefficient in their energy consumption, and their use is being phased out over time.

Electronic ballasts will become the norm—Electronic ballasts meet the energy efficiency guidelines laid out in the 2005 NEPA. As time passes, these ballasts will become standard.

Commercial-grade electronic ballasts regulate voltage and current quietly and efficiently, and they seldom produce audible noise. These ballasts used to cost twice as much as magnetic ballasts, but as they become more common, prices will become more reasonable.

Some of the cheaper 4-ft. shop lights sold at many retail outlets contain an inexpensive electronic ballast that does not meet the industry standards for commercial ballasts, meaning that lamp life and light output may suffer. □

Jack Lindsey retired to the mountains of Oregon in 1996 after a long career as an engineer for the Southern California Edison Co. specializing in commercial and industrial lighting.

Clean lights are more efficient

A little routine maintenance goes a long way toward maximizing the performance of your lighting system. Fixtures and lamps collect dirt and dust, even in the cleanest of shops, and a good dust collector and a ceiling-mounted dust filter can't capture all of the dust from woodworking equipment. Dust and dirt on lamps and fixtures can reduce light output by 10% or more during the first year, with additional losses of 5% or more each year after that. You should clean fixtures and lamps at least once a year to recover this loss. First turn off the power to the fixture. Then remove the lamps, and wash both the lamps and the fixture with a mild solution of water and dishwashing detergent. Rinse with a damp cloth, and dry the surfaces with another clean cloth, or let them air-dry before turning on the power again.



Clean lamps shine brighter. *Dust reduces the light output of fluorescent lamps. Clean them at least annually with a damp cloth and dishwashing detergent.*



Add a Wood Floor

Insulated plywood floor is easier on your body and tools

BY SCOTT GIBSON

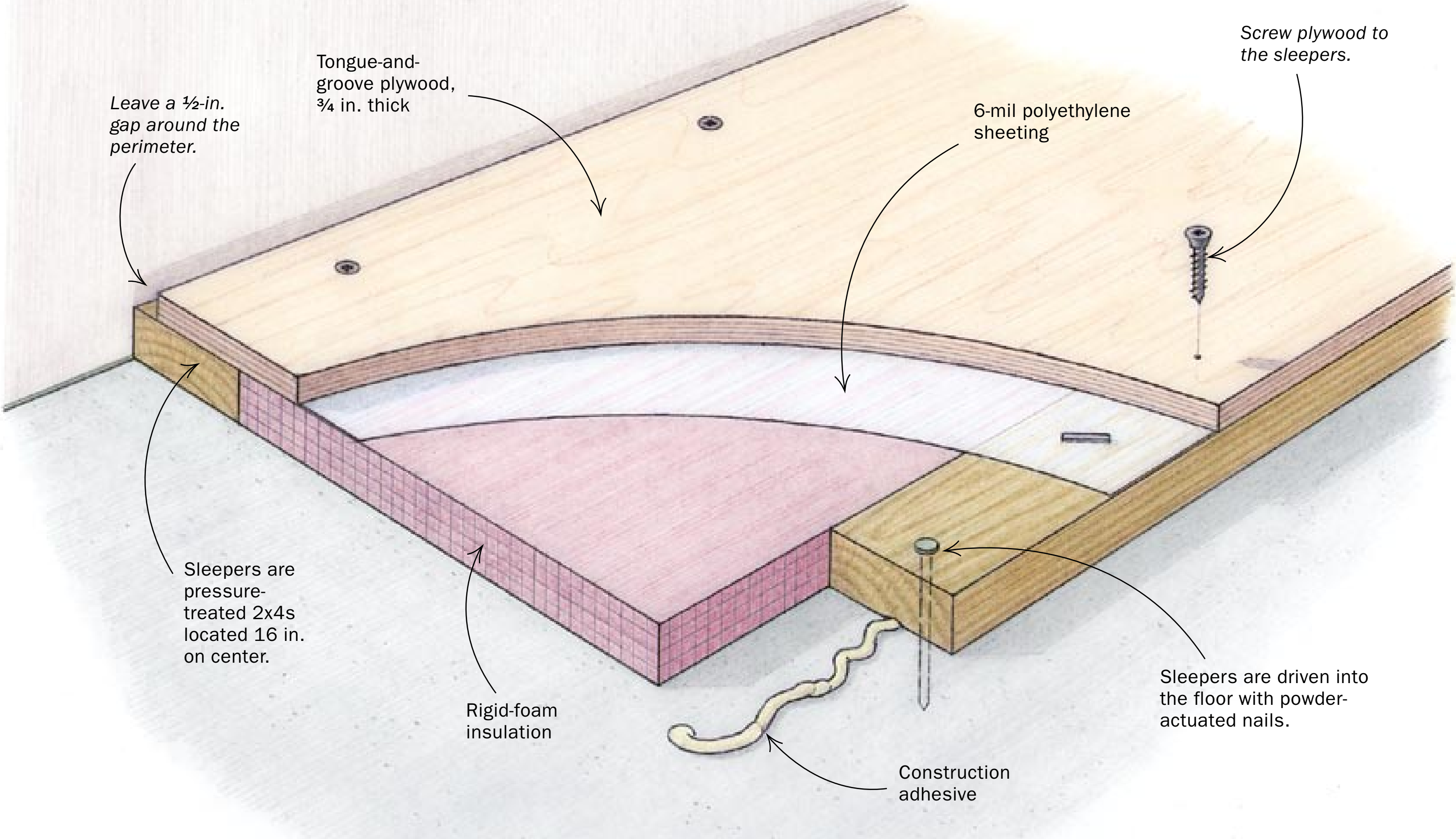
Many a shop is a converted two-car garage built on a concrete slab. I'll say this much for concrete: It's easy to sweep clean. It's also unforgiving. By mid-afternoon, feet hurt. By evening, a dull ache creeps up the back. Tools can be damaged if they're dropped on concrete. And in cold climates, concrete can be a heat sink.

One solution is to install a wood floor directly over the concrete. Wood flooring has a lot of advantages: It is easier on your feet, as well as any tools that happen to roll off the bench. Electric cable can be routed beneath the flooring to power equipment located away from walls. Stationary tools, workbenches, and other fixtures can be screwed down easily. If there is enough headroom, a wood floor can be raised enough to locate dust-collection ducts below. If that's not enough, the cost of material for covering a concrete floor with wood is minimal—about $2 per square foot.

Photos: Tim Sams; drawings: Vince Babak

PLYWOOD FLOOR OVER CONCRETE SLAB

For a permanent floor, attach 2x4s to the concrete slab using construction adhesive and powder-actuated nails.



A floor consisting of 2x4 sleepers and ¾-in.-thick plywood is only 2¼ in. thick. However, if a wood floor is going to drop the ceiling height to less than 8 ft., I'd think twice about adding one.

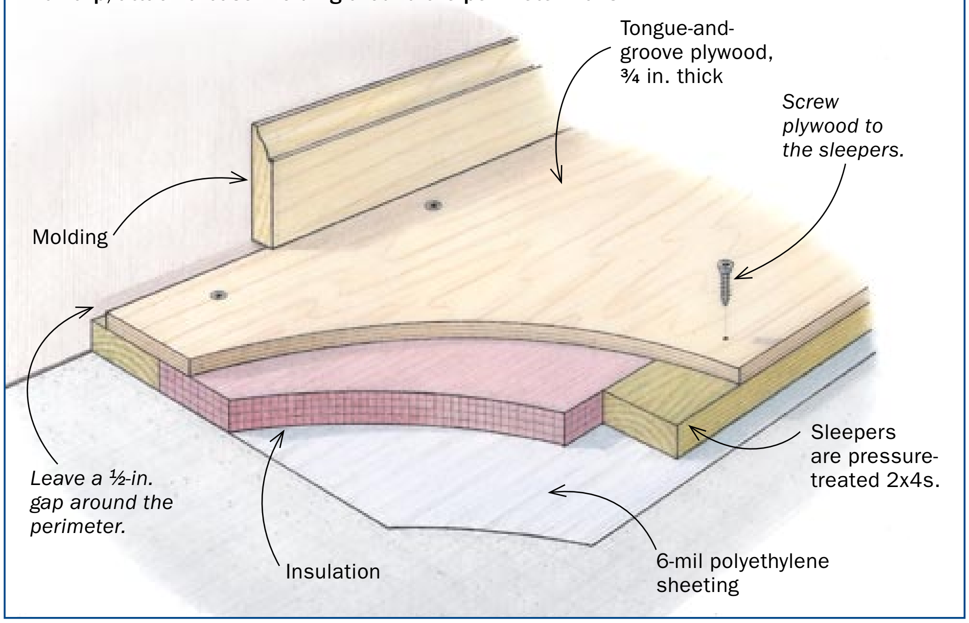
Lay out the sleepers first

Because the sleepers will be in direct contact with concrete (for a permanent floor), they should be pressure-treated material rated for ground contact. Concrete can absorb water like a sponge, and untreated wood not only decays, but it also invites carpenter ants and termites.

Don't forget to wear eye and lung protection when cutting pressure-treated wood and to wear gloves when handling it (splinters are nasty). Even though damp concrete won't degrade pressure-treated material for a very long time, really serious water problems should be cured before the new floor goes down. In a basement shop, that may mean cutting a trench at the perimeter of the room and installing a

TEMPORARY FLOOR

For a removable floor, leave out the adhesive and fasteners, and place the polyethylene sheeting directly on the concrete. To keep the floor from lifting should it warp, attach a base molding around the perimeter walls.



GLUE AND NAIL THE SLEEPERS







Construction adhesive and nails provide added holding power. *Lay a bead of glue under each sleeper, then nail it to the concrete using a powder-actuated driver.*

subsurface drain system and sump pump. Better to do that now.

Sleepers are laid flat, not on edge, over the concrete. They should be spaced 16 in. on center so that the long edges of the plywood always fall on solid wood (see drawings, p. 93). An easy way to get the layout right is to snap chalklines on the concrete to mark the edge of each 2x4. Snap the first line 14¾ in. from the wall, then add 16 in. to each successive line. Sleepers will span minor gaps and voids in the concrete, but serious dips should be filled. Be sure to use a cold chisel to knock off any obstructions that would prevent the sleepers from lying flat.

Once all of the sleepers have been cut to size, place them on or near the layout lines. Then, starting at one end of the room, pick up a sleeper and lay a fat bead of construction adhesive on the floor where the center of the sleeper will fall. Press the sleeper into place. Adhesive alone should hold down the 2x4s, but I recommend using powder-actuated nails, which will ensure that the wood is secure. Powder-actuated nails are inexpensive, and you can find them at a

Concrete: The floor of hard knocks

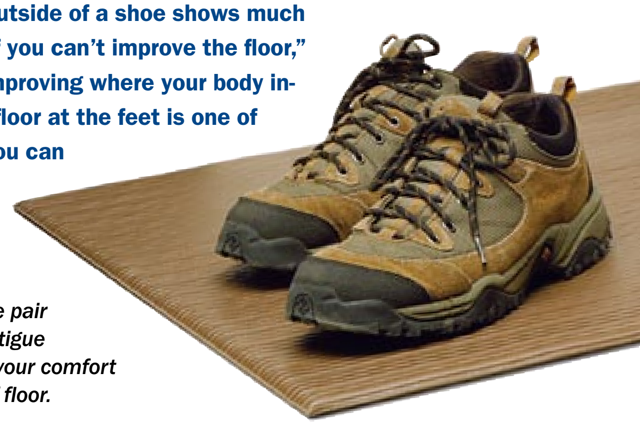
Industrial ergonomists—specialists who look for ways to make the workplace more user-friendly—would rather see you work on almost any surface other than plain concrete.

"Concrete floors are a very hard, very dense material. As a result, if you have to stand on them for any length of time, most likely you're going to experience some level of discomfort," said Rob Nerhood, director of consultative services for the NC Ergonomics Resource Center in Raleigh, N.C.

Dan MacLeod, a consultant in ergonomics in Milford, Pa., said standing on hard surfaces can result in a variety of ailments, including fatigue, stress on the spinal column, and heel spurs. "The latter is more or less a type of tendinitis of the heel," he said, "the symptoms for which are sore heels, particularly in the morning when you first get out of bed."

Adding a floor of 2x4 sleepers and plywood over a concrete slab does provide some relief. But consider also using antifatigue mats. Nerhood said the goal is to provide a material that can be compressed, even slightly, as a buffer between a worker's feet and a hard floor.

Don't overlook your work shoes, either. Insoles can wear out long before the outside of a shoe shows much wear and tear. "If you can't improve the floor," Nerhood said, "improving where your body interacts with the floor at the feet is one of the good steps you can take." No pun intended.



The cure for sore feet. *A comfortable pair of shoes and antifatigue mats will increase your comfort level on any type of floor.*

local hardware store. Don't, however, skip the adhesive and rely on powder-actuated fasteners alone. Over time, the floor can wiggle loose. Because the adhesive starts to dry quickly, glue down one sleeper at a time. Remember to leave a ½-in. gap between the walls and perimeter sleepers. In a cold climate, a layer of rigid-foam insulation cut to fit snugly between the 2x4s helps keep out the chill.

Follow with plastic sheeting and plywood

Once the 2x4s have been anchored to the floor, they should be covered with a layer of 6-mil polyethylene sheeting. The sheeting prevents moisture from migrating up through the floor and protects the plywood from damp air. Overlap any seams by 6 in. and tape them with housewrap tape. If the floor is not to be permanent, omit the adhesive and fasteners and allow the sleepers to float on the concrete. Lay the polyethylene directly over the concrete first, then lay the sleepers on top of the polyethylene (see bottom drawing, p. 93).

Plywood is next. My first choice would be ¾-in.-thick tongue-and-groove, exterior-grade plywood, but you also can use oriented-strand board (OSB), which is less expensive. Arrange the sheets so that the seams are staggered. That is, start in one corner with a half sheet. On the next course, start with a full sheet. That way, the seams will be staggered 4 ft. apart. The plywood can be nailed to the sleepers, but screws allow you to remove and replace damaged plywood sheets easily. Fasten the plywood every 16 in. with either steel wood screws or drywall screws.

Although plywood is more dimensionally stable than solid wood, it's not a good idea to run the edge of the sheets right up to the wall. Leave a gap of ½ in. all the way around to give the plywood a little breathing room. You can cover the gap with a piece of baseboard or shoe molding.

Finishing the floor is a matter of personal preference. A coat or two of paint or clear finish will help protect the plywood from the inevitable coffee or paint spill. But for a shop, that may be more trouble than it's worth. Your feet, knees, ankles and back—as well as your edge tools—will be just as happy with an unfinished floor. □

Scott Gibson is a woodworker and writer in East Waterboro, Maine.

INSULATION, VAPOR BARRIER, THEN PLYWOOD



Insulation to keep your toes warm. *In colder climates, place rigid insulation between the rows of sleepers.*



Sheeting provides a vapor barrier. *Spread 6-mil. polyethylene sheeting across the top of the sleepers and insulation. Cover the whole space, and if you need more than one sheet, overlap seams by 6 in.*



Get the first piece right. *Take your time placing the first plywood sheet because all of the other pieces will follow its course. Be sure to leave a ½-in. gap at the walls around the perimeter to give the plywood some room to expand.*



SHOP **UPGRADES**

Ready-Made Flooring

Quick, effective cures
for a cold, concrete slab

BY ANATOLE BURKIN

Concrete is a perfect shop floor for machines. But it's not so kind to the body or to the occasional dropped hand tool. Concrete is especially nasty in the winter if your shop is in a detached building. And no matter how high the indoor-air temperature gets, the floor is always cold, even in warmer months.

Determined to get off the slab and to do it with a minimum of fuss, I surveyed what floor coverings were available. My primary goal was to find products that would be easy to install and would keep my feet from freezing in winter. Of secondary importance was to find products that acted as a moisture barrier, could protect a dropped tool, and were easy to keep moderately clean.

I found five types of flooring products that seemed to meet all of those criteria. One is a wood composite; the others are PVC based.

Wood composite vs. PVC

The wood-composite product, called DRIcore, is a subflooring material made of random waferboard bonded to a high-density polyethylene base. This tongue-and-groove product was created as a base for carpet, vinyl tile, or engineered hardwood flooring, but it may be used as is. A mallet and a jigsaw are all the tools required for installation.

The PVC products are available in tiles or rolls in an assortment of colors. The interlocking tiles (Tuff-Seal, Lock-tile, and Resilia) can be installed with a rubber mallet and trimmed with a utility knife.

PVC roll flooring (Better Life Technology) unrolls like a carpet and can be trimmed with a utility knife. Adjoining sheets may be laid side by side or attached to the floor at the seam with carpet tape.

Performance underfoot

I assembled samples of each flooring type, and they fit together easily. The PVC products were best assembled at room temperature, between 60°F and 70°F, which made them pliable and easy to connect.

All of these flooring products provided some insulation from the concrete slab, which can reduce the rate of body-heat loss. Covering concrete with flooring also resulted in a slightly warmer

WOOD-COMPOSITE TILES

Although they're designed to be a subflooring material, on shop floors these large tiles can be used as is. Easy to install with tongue-and-groove joinery, the tiles help insulate you from a cold floor.

DRICORE

Available at Lowe's
www.dricore.com

The ⅞-in.-thick DRIcore panels are about 2 ft. square and fit together with tongue-and-groove joints. The fit between adjoining tiles was good, but not as neat and tight as with PVC tiles (see p. 98). This is the only flooring product that has a leveling system in which dedicated spacers are used to correct for minor imperfections in your floor. No fasteners or glue is needed. The clear acrylic finish is not meant as a wear surface but as a sealant; however, the manufacturer says it can be topcoated with a non-water-based paint or a polyurethane floor finish.
Approximate cost: $1.47 per sq. ft.



The insulation factor. *After the concrete floor and the acclimatized DRIcore tile are checked with an infrared thermometer, the readings show a 4.5°F difference. The polyethylene underside elevates the tile, providing a moisture barrier and adding to the insulation factor.*



INSTALLING WOOD-COMPOSITE TILES



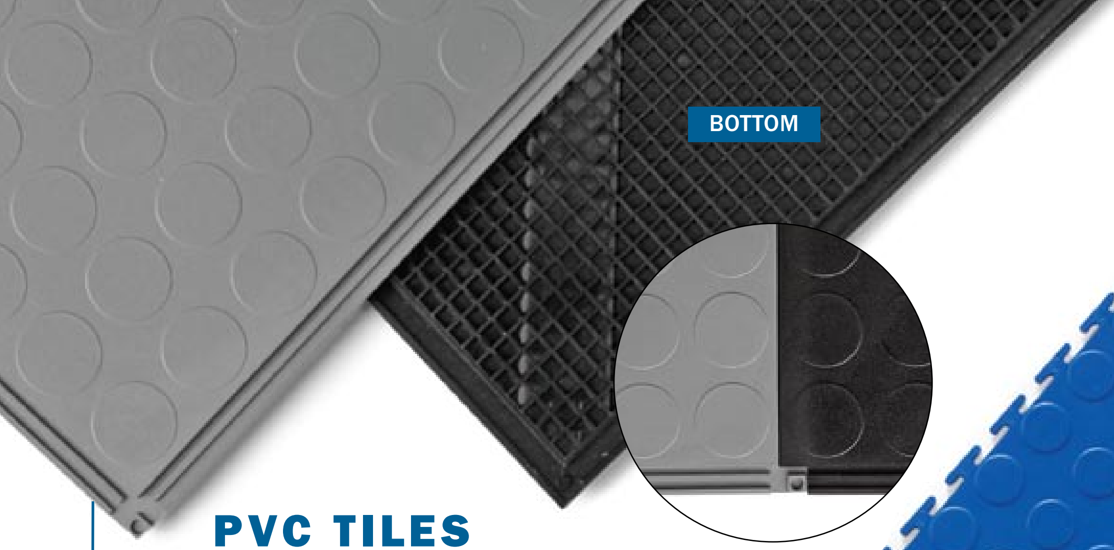
Knock tiles together. *Protect the tongue-and-groove edge with a block when knocking the tiles into place with a mallet.*



Install leveling spacers where needed. *These compensate for any unevenness in the floor.*

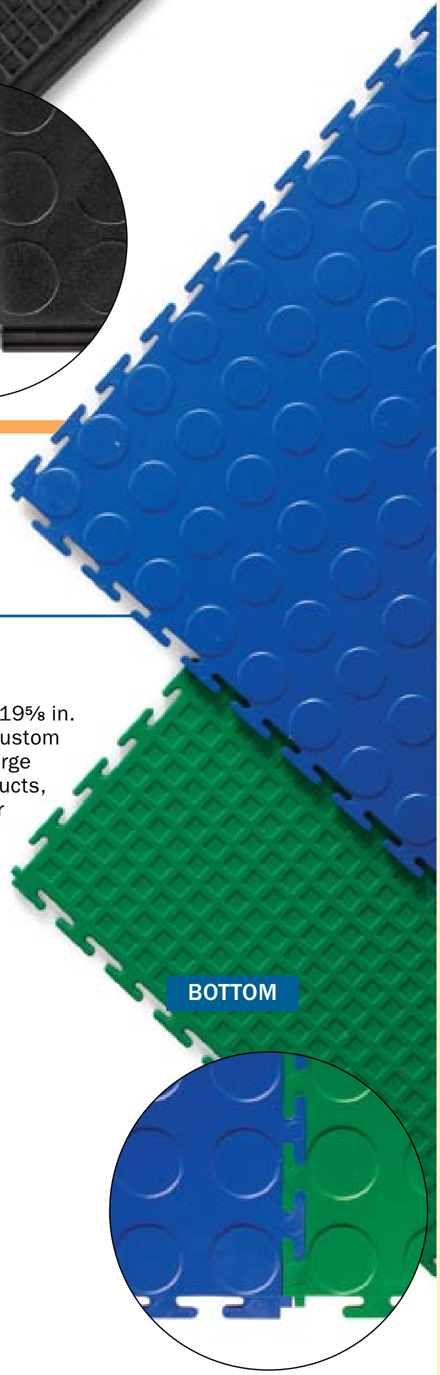


Trim to size with a jigsaw. *Make sure the tiles are on a stable support.*



PVC TILES

Available in a variety of colors and sizes, PVC tiles have interlocking tabs, some of which create almost invisible seams. Quick to install and ready for immediate use, these tiles lend a bright and modern look to a concrete floor.



RESILIA

FloorSurfaces Inc.
www.floorsurfaces.com

Resilia interlocking tiles come in a choice of 20 colors, and for a surcharge, custom colors may be ordered. These ¼-in.-thick tiles are 12 in. square and have a hidden interlocking joint, which leaves only a hairline seam between tiles.
Approximate cost: $3.45 per sq. ft.

LOCK-TILE

Evertile Flooring Co.
www.locktile-usa.com

Lock-tile pieces are ¼ in. thick and 19⅝ in. square. They come in nine colors (custom colors may be ordered but only in large quantities). Like other PVC-tile products, these can be installed with a rubber mallet and a utility knife. The interlocking tabs create a snug but exposed joint.
Approximate cost: $3.20 per sq. ft.

TUFF-SEAL

Flooring Adventures
www.tuffsealtile.com

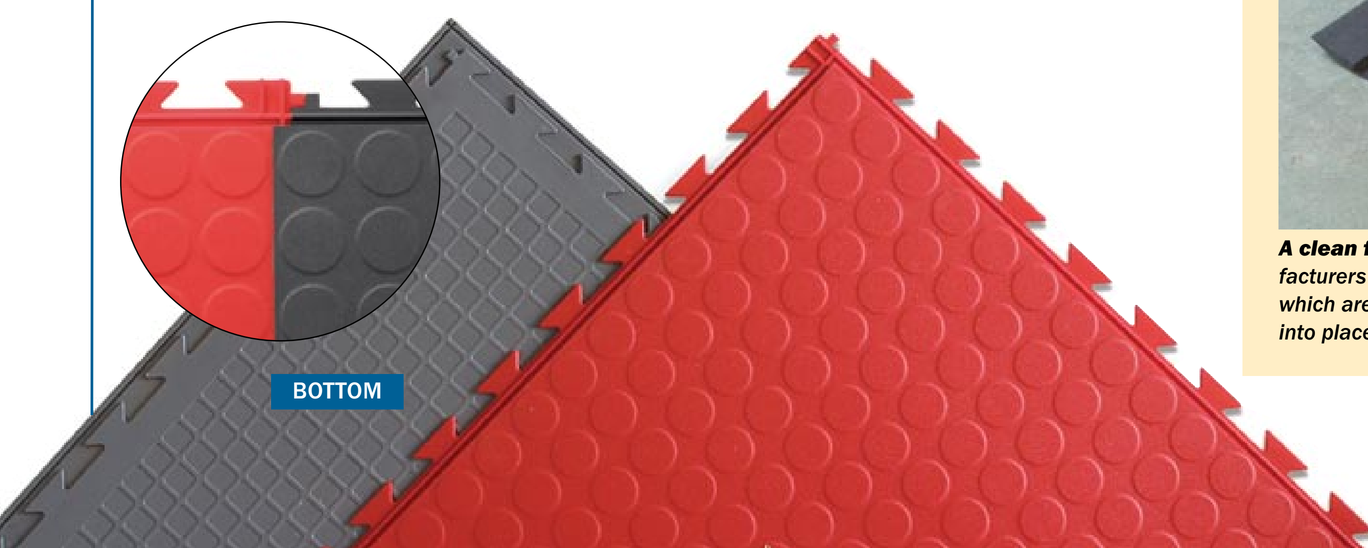
Tuff-Seal PVC tiles are ¼ in. thick and 18 in. square and come in seven colors. The hidden interlocking dovetail-shaped tabs seemed to be the best-designed joint of all the samples; the connection is secure and nearly invisible, leaving only a hairline gap between adjoining tiles.
Approximate cost: $4.95 per sq. ft.

OTHER SOURCES OF PVC TILES

Craftsman garage tiles
Approx. $2.75 per sq. ft.
www.sears.com

Gladiator Flex Tile
Approx. $4.52 per sq. ft.
www.lowes.com

Trafficmaster garage tiles
Approx. $2.47 per sq. ft.
www.homedepot.com



LAYING PVC FLOORING



The tight interlocking tabs are joined easily with a mallet. *Knock the interlocking edges into place with a rubber mallet for a snug, flush seam.*



Trim the tiles with a utility knife and a straightedge. *PVC tiles are thin enough to be cut to size with a standard utility knife.*



A clean finish. *Some manufacturers offer edge strips, which are snapped on or glued into place.*

floor temperature. Using an infrared thermometer, I found that the floor temperature increased by 2°F with the PVC products. With the wood composite, though, the floor temperature increased by a noticeable 4.5°F. All of these products also act as vapor barriers, which, depending on how the concrete slab is constructed, may reduce the humidity in your shop.

To see how well these flooring products could protect a tool from mishap, I dropped a sharp 1-in. chisel from waist height onto each sample. In all cases, the flooring prevented the edge of the chisel from chipping. All of the flooring samples suffered only minor damage, except for the Better Life Technology PVC sheet, which was partially punctured. Such a fine slit, however, is unlikely to degrade the product.

I dabbed each sample with typical shop chemicals such as naphtha, alcohol, and oil stain, and saw no damage. Except for the DRIcore tiles, which absorbed some stain, all of the flooring cleaned up easily.

What to choose for your shop

It seems you couldn't go wrong with any of these flooring products, based on the ease of installation and the insulation improvement. Budget, however, may be a factor in your decision (prices are noted in the comments about the individual products), as may be aesthetic considerations. For instance, the PVC flooring comes in numerous colors. You could even make a checkerboard pattern if you go with the PVC tiles. PVC also is a durable substance, and it might wear better than wood composite.

There's another point worth mentioning: During the course of my review, a number of people asked me which of the flooring products was more comfortable to stand on. I can't say any of them is a substitute for antifatigue mats, which have a lot more give. But I did appreciate the insulating qualities that the DRIcore tiles provided during cold weather.

Anatole Burkin is the publisher and former editor of Fine Woodworking.

PVC ROLLS



This material covers a concrete floor in no time, lending a clean and uniform covering. Although durable, it is thinner and more flexible than the PVC tiles.

BLT (BETTER LIFE TECHNOLOGY)

www.bltllc.com

BLT's PVC floor covering comes in a roll. The material is about ⅛ in. thick and is available in various widths and lengths and in six colors. BLT's covering is the easiest product to install: simply unroll it. Adjoining sheets can be butted together, but for a better joint, tape mating edges to the concrete with indoor/outdoor double-faced tape.

Approximate cost: $2.60 per sq. ft.

OTHER SOURCES OF PVC ROLLS

Armor
Approx. $2.07 per sq. ft.
www.armorgarage.com

Gladiator
Approx. $2.59 per sq. ft.
www.lowes.com

ROLLING OUT PVC FLOORING



Cover a large surface in no time. *The large, heavy rolls are easy to install once in position. Wait for warm weather, as the PVC material is more pliable and easier to unroll above 60°F.*



Trim with a utility knife. *Before trimming the excess material, allow it to relax at the base of the wall.*



Hold down edges with tape. *When taping the edges, use indoor/outdoor double-faced tape.*

Photos, except where noted: Marcia Ryan; product shots: Matthew Gardner; p. 97 (top): Robin Burkin



Dust Collection

Set up a powerful system that fits your needs



Woodworkers have been battling sawdust ever since the ancients invented the handsaw about 5,000 years ago. The Egyptians cleverly disposed of at least some woodworking debris by using it to stuff mummies, but this is not an option for today's woodworker.

In more recent times, the dust and chips created by woodworking machines have grown vastly more plentiful, finer, and more hazardous. Prolonged exposure can cause respiratory problems and has been linked to the development of some types of cancer. So keeping all of this material out of the air and off your tools and floor, and gathering it for disposal, have become more urgent and more challenging tasks.

Enter the dust collector.

A woodshop dust collector is a simple exhaust system. Its blower moves contaminated air through hose or ductwork to filters, which clean that air for recirculation back into the shop. The more effective the blower, the more ductwork you can add and still have enough suction at the other end to do the job.

For many woodworkers, a shop vacuum is the first dust collector. A shop vac can handle small amounts of fine debris like that produced by a 5-in. orbital sander or a router. But a shop vac moves small volumes of air, making it a poor choice for larger stationary machines.

Dust collectors generally belong to one of two families. Single-stage collectors carry the sawdust and other debris directly through the impeller, or fan, and into filter bags or cartridges. Two-stage cyclone collectors allow heavier debris to drop out of the airstream before it reaches the blower, meaning less work and abuse for the impeller and filters.

The more air a dust collector moves, the more debris it can carry. Dust from a small hand sander might be captured effectively

Photos: Steve Scott

Demystified

BY STEVE SCOTT

with as little as 100 cubic feet per minute (cfm), but a tablesaw might require 800 cfm. Also, the faster a collector moves the air, the heavier the debris it can carry. The lightweight dust from a small sander might need an airspeed of as little as 3,000 linear feet per minute. The coarser material produced by a planer often demands as much as 4,000 fpm. Finally, the more effective a dust collector's filters, the less fine dust will be returned to the air.

Dust-collection systems are like many other things in life: The safest approach is to plan for the worst. Some modestly powered

A shop vac isn't enough



Choices in dust collection range from light-duty shop vacs to powerful cyclone-style dust collectors. A shop vac might be your first dust collector, but it shouldn't be your last. Shop vacs can handle the dust from small tools but are undermatched for the amount of waste that a stationary machine can throw. In choosing the collector, consider how frequently you use machines that produce large volumes of dust and chips. You also should weigh whether you need a collector that can support long segments of ductwork.



SINGLE-STAGE DUST COLLECTOR

The strongest of these, 2-hp and 3-hp units, can collect dust effectively from a tablesaw or other large machine through several feet of duct or hose. Units rated at 1½ hp deliver top performance only at shorter distances. The 1-hp units may have trouble clearing all the debris from large machines. Prices range from $150 (1 hp) to $800 (3 hp).

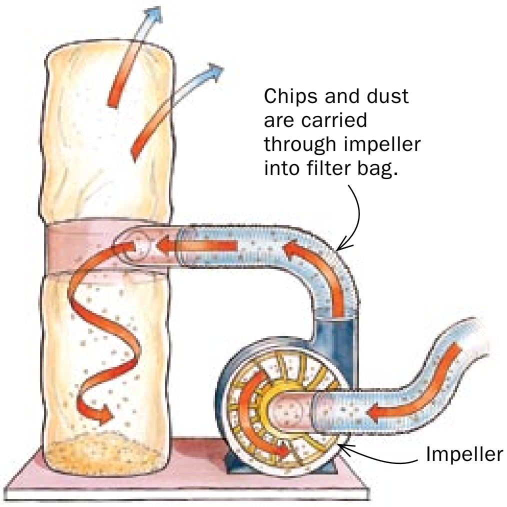


TWO-STAGE CYCLONE

These units move more air with the same horsepower as their single-stage counterparts, offering as much capacity as most home shops are likely to need. If you want complete freedom on shop layout and ductwork, this is your best bet. Prices start around $750.

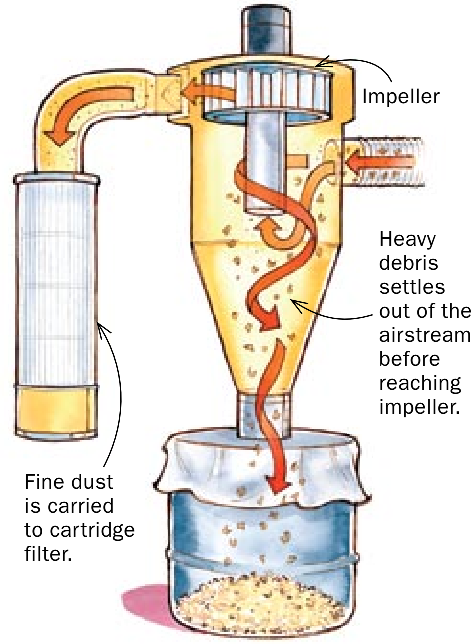
Single- or two-stage dust collector?

Both will do the job, if connected to the right hose/duct setup. The difference is a matter of cost and convenience.



SINGLE STAGE

A single-stage dust collector carries all of the debris past its impeller and then separates it into heavy chips and lightweight dust. It is the more affordable option.



TWO-STAGE CYCLONE

A two-stage cyclone allows larger debris to fall out of the airstream before it reaches the blower. This lets the impeller spin more freely while being more efficiently shrouded, increasing airflow. The filter sees far less dust, which reduces maintenance.

dust collectors can deliver 800 cfm only if connected to a machine by less than 4 ft. of flexible hose. The bigger challenge lies in collecting dust from machines on the far side of the room. A key question to consider about any dust collector is how much ductwork it can support.

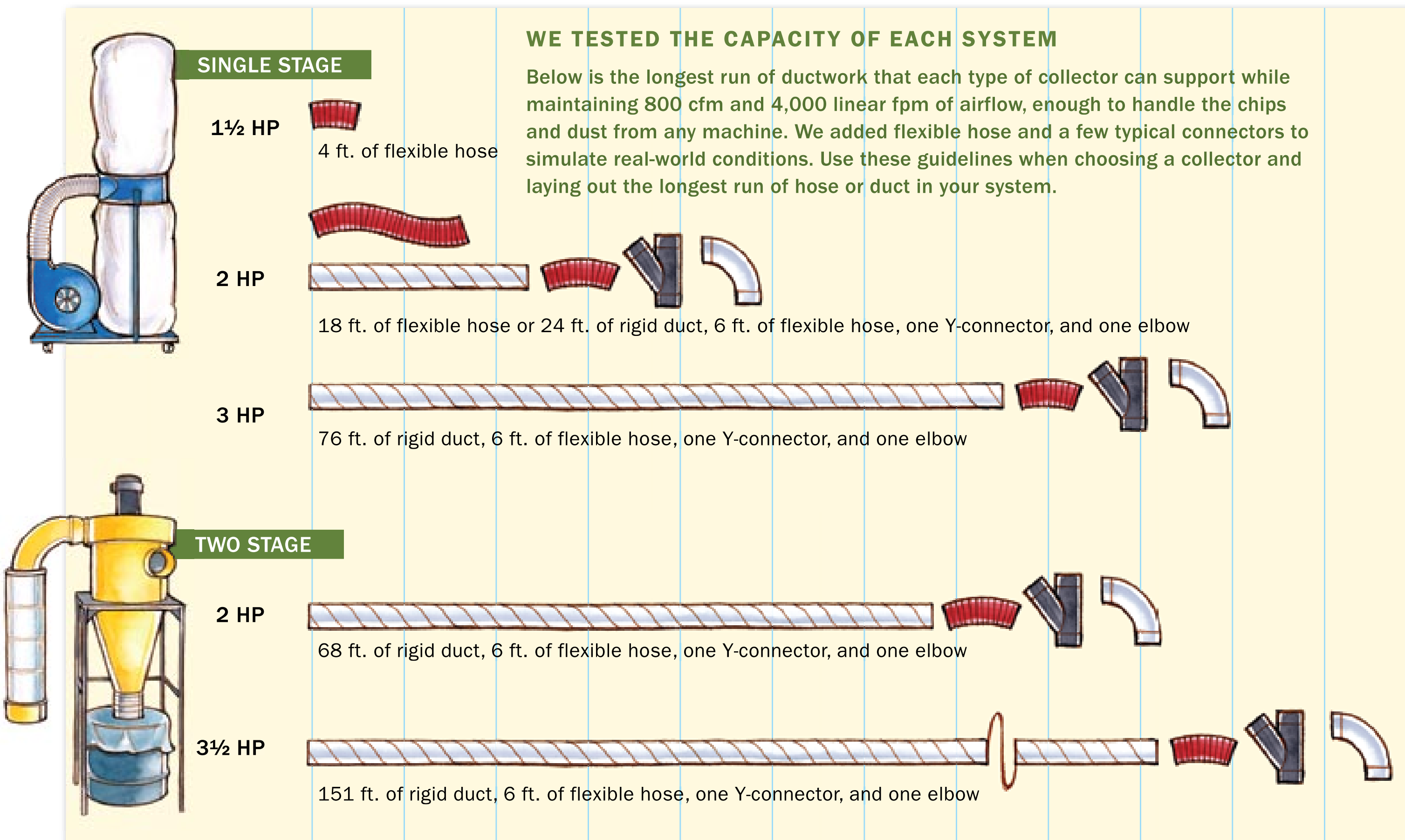
We tested a sampling of collectors ranging from a 1-hp single-stage unit to a 3½-hp cyclone. We used the results to estimate how much ductwork each machine might support while delivering the baseline performance of 800 cfm and 4,000 fpm.

Which equipment is right for you? This survey should help clarify your choices.

A single-stage portable works for smaller shops and budgets

For a woodworker with a garage shop that includes a tablesaw, jointer, planer, and bandsaw, and with $600 or less to spend on dust collection, the most practical choice is a single-stage dust collector.

A 1-hp collector is the least expensive, but you're likely to be disappointed with its performance—about 450 cfm at best. Unless your larger machines have perfectly efficient dust-collection hoods or ports (extremely rare), that's not enough.



Drawings: Stephen Hutchings

The 1½-hp collectors are the most powerful units that run on standard 110v current. They work well, given a minimum of flex hose and frequent cleaning of filters.

If you have 220v power, though, consider stepping up one rung in class (and price). The 2-hp single-stage collector that we tested handled the equivalent of 18 ft. of flex hose before dropping below 800 cfm and 4,000 linear fpm.

Because the collector is mobile, you can wheel it from machine to machine, connecting it to each via a short length of hose. This ensures optimum performance at each machine, but sacrifices convenience.

An alternative is to park the collector in a central location and use Y-connectors, blast gates, and a couple of hose runs to connect it to your most frequent offenders. This approach lets you operate a variety of woodworking machines without undoing and redoing dust-collector connections. Put machines that generate less dust at the farthest end of the hose. Use a shop vac to handle the lightest-duty machines.

It's worth pausing at this point to say a few words about filters. Dust smaller than 10 microns—about half the thickness of this page—can be inhaled far more easily than expelled; once lodged in the lungs, it can cause a host of health problems.

Many single-stage collectors come with woven fabric bags that, when new, capture particles as small as 30 microns. Their performance improves with use, as a layer of fine dust builds up on the filter surfaces. This works, but erratically: Plenty of hazardous dust escapes while the coating accumulates, and the coating will often release sudden puffs of ultrafine dust through the fabric and into the shop.

You will breathe easier with 1-micron filters, but they still require fairly frequent cleaning. In contrast, the accordion pleats of cartridge filters allow much more filter area in the same space, increasing intervals between cleanings by three to 10 times. A warning: Cartridge filters can be more delicate than cloth bags. A protective screen at the filter's intake is a good idea.

As a last word on single-stage collectors, there are more powerful units available. A 3-hp single-stage collector can be left in a corner and connected to a significant amount of pipe. The one we tested will provide sufficient airflow and velocity at the end of 76 ft. of ductwork, plus an elbow, a Y-connector, and 6 ft. of hose. On

Two ways to use a single-stage collector



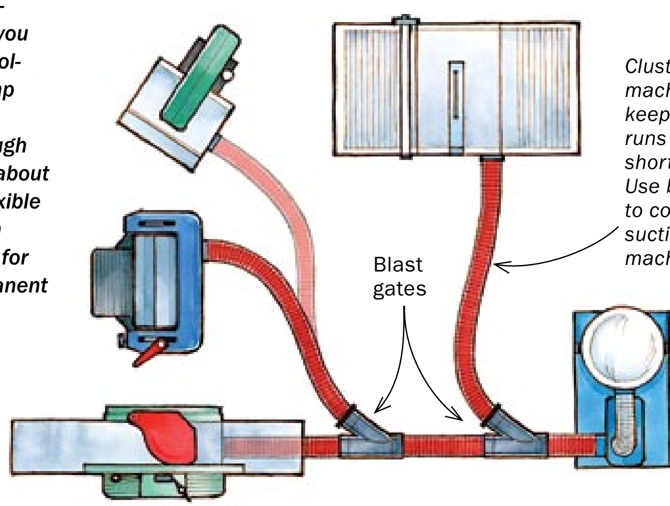
ONE MACHINE AT A TIME

Fitted with a short length of hose, a 1½-hp or 2-hp collector can be wheeled around the shop and connected to each machine as needed.



MULTIPLE MACHINES

More horsepower lets you park your collector. A 2-hp machine is strong enough to support about 18 ft. of flexible hose, which also allows for semi-permanent connection to several machines at once.



Cluster your machines to keep maximum runs of hose as short as possible. Use blast gates to concentrate suction on one machine at a time.

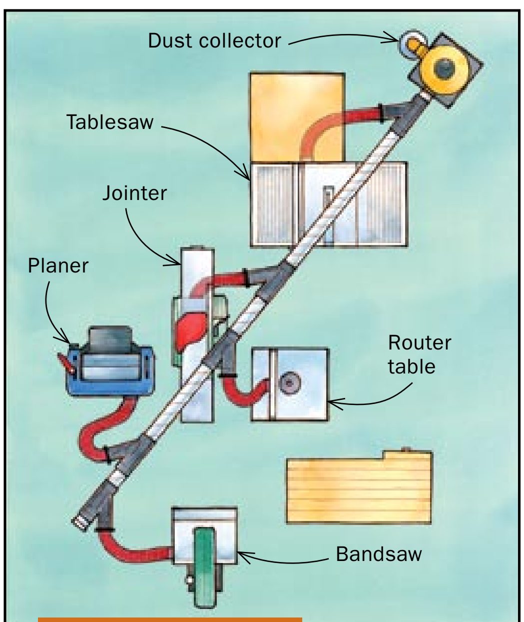
Bigger dust collectors offer more shop layout options



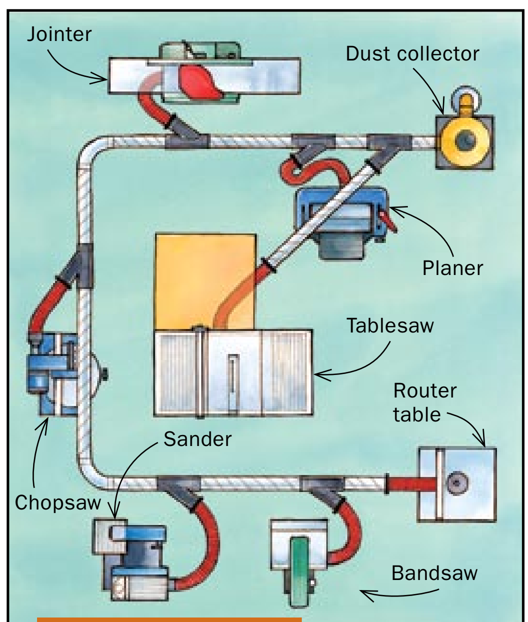
ONE-WALL LAYOUT

THREE POSSIBLE DUCTWORK CONFIGURATIONS

Cyclone collectors are powerful enough to support permanent installations of fixed ductwork. Run ductwork along one wall (above) and use branches of duct or flexible hose to reach machines. A diagonal duct run (near right), mounted overhead, works well for tools in the middle of the room. A duct run around the shop's perimeter (far right) can be mounted overhead or on the walls and works best for tools positioned along the walls.



DIAGONAL LAYOUT



PERIMETER LAYOUT

the downside, the collector will take up about 10 sq. ft. of shop space, and you'll have four filter bags to clean, not just two. In addition, a collector in this 3-hp class costs about $500. Upgrading the filter bags, which often is necessary, might cost another $400. That's before ductwork.

Once you've reached that level of expense, it's worth considering a cyclone.

A cyclone is best for fixed ductwork

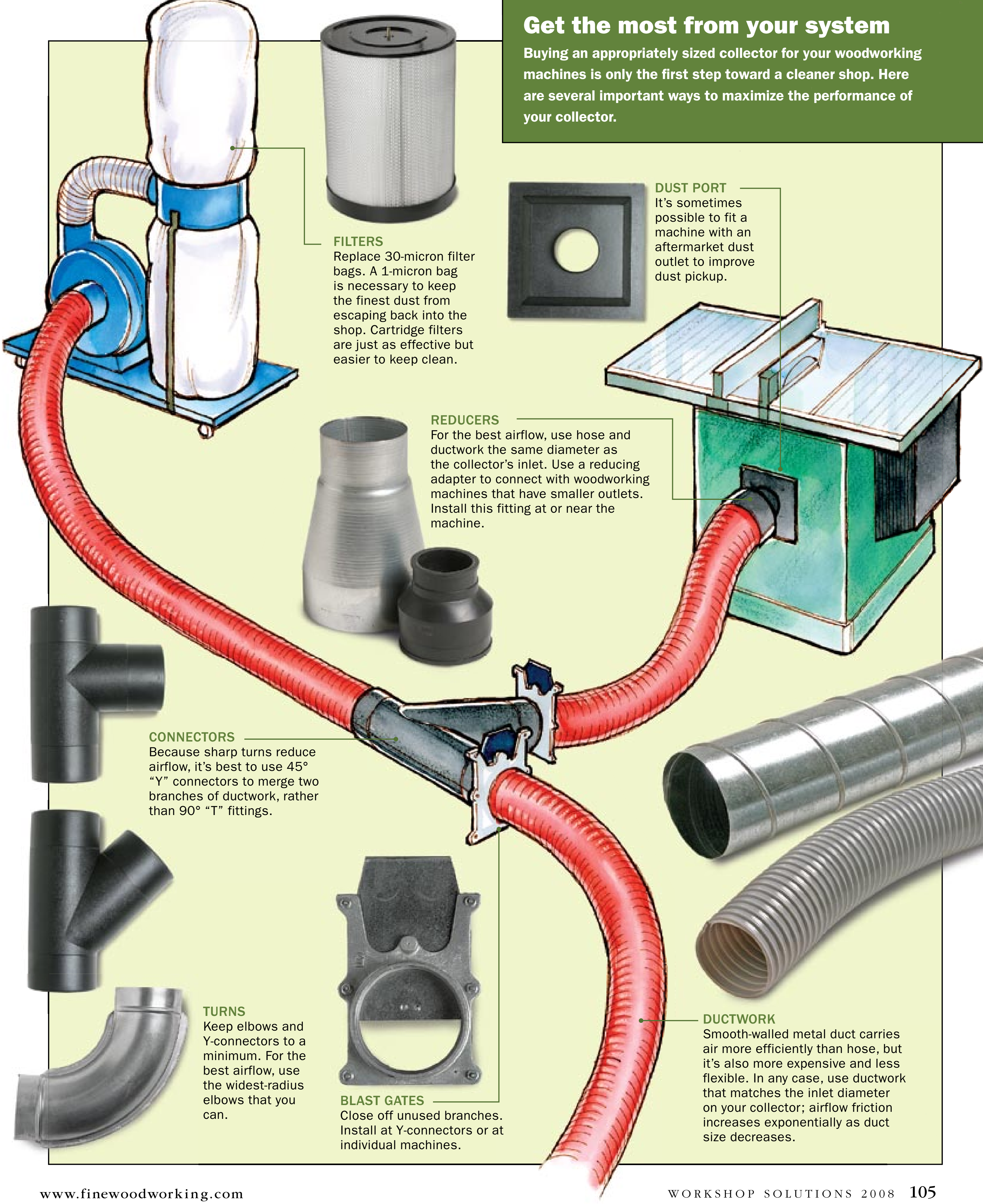
The cyclones we tested range in price from $750 to $1,200 and come with good cartridge filtration. Any of them can quickly move high volumes of air through enough ductwork to span the length and width of a two-car garage. If you plan to spend $2,000 or so, the purchase price leaves plenty of cash for that ductwork. Your choice should be guided by your own shop layout. How spread out are your machines?

The 2-hp unit we tested, for instance, can support roughly 68 ft. of ductwork, one elbow, one Y-connector, and 6 ft. of flex hose. As you might expect, the 3½-hp machine will handle larger loads. Tests show that it will deliver similar performance with up to 151 ft. of straight ductwork and the same elbow, Y-connector, and length of flex hose. There are larger cyclones on the market, but they provide more capacity than a home shop is ever likely to need. □

Michael Standish provided research and testing for this article.

Get the most from your system

Buying an appropriately sized collector for your woodworking machines is only the first step toward a cleaner shop. Here are several important ways to maximize the performance of your collector.



Shop Heating Options

For every shop and climate, there's an efficient solution

BY ANDY ENGEL



WALL MOUNT

Often an easy option, the electric versions require no venting, while the fuel-fired models vent through a small hole in the wall. All of these heaters occupy valuable wall space.

My first woodworking shop was in a garage in northern New Jersey. I cobbled together some insulation, weatherstripping, and an old woodstove to make the shop mostly habitable—for me. For my tools and projects, though, I suspect it was a hostile environment. Morning often found the shop below freezing, which precluded storing glue or waterborne finishes there. Stoking the stove quickly launched the mercury into the 80s, a fluctuation in temperature and humidity that did my lumber no good. And, if the shop remained unused for any length of time during the winter, rust bloomed on my tools.

Better insulation and a heater I was comfortable burning in my absence would have fixed the problems. I think 50°F is good for an empty shop, and with decent insulation and air sealing, it's a temperature that shouldn't cost an arm and a leg to maintain in most climates.

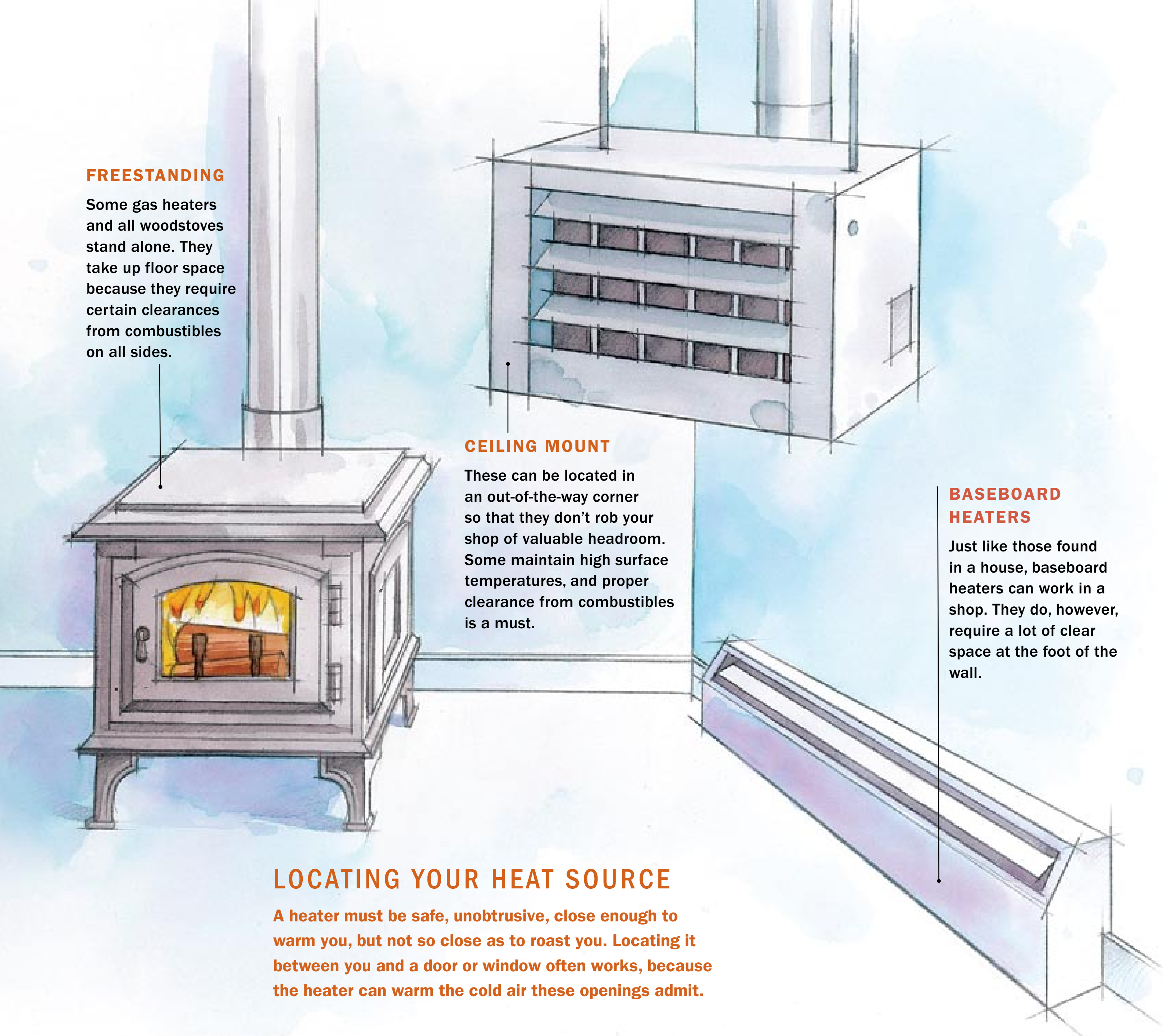


Dust and fumes can be a hazard

Wood dust will burn at 500°F or less, and clouds of dust can ignite if they're exposed to hot surfaces or an open flame. Aside from the fire risk, even relatively minor shop dust encrusting any type of heater will make it less efficient.

There are two types of fuel-burning appliances. Open-combustion appliances, such as woodstoves or gas heaters with pilot lights, feed the flame with air from inside the room and are potential ignition sources in dusty environments. Sealed-combustion appliances, such as most direct-vent kerosene heaters and many gas heaters, have no connection between the combustion chamber and the inside air. Rather, a supply duct brings air from outside into the chamber to support the flame. These are safer.

Photo, this page: Michael Pekovich; drawings: Brian Jensen



LOCATING YOUR HEAT SOURCE

A heater must be safe, unobtrusive, close enough to warm you, but not so close as to roast you. Locating it between you and a door or window often works, because the heater can warm the cold air these openings admit.

As a practical matter, a woodworker who installs a decent dust-collection system probably will never create enough airborne dust to make the atmosphere truly risky. Most types of heaters should be safe to use in a shop as long as you collect the dust, don't allow flammable fumes to build up, and clean off the heater on a regular basis. To limit the risk, ask the manufacturer if the surface temperature of the heater will exceed 500°F or if there's an open flame. It's a good idea to check with your building inspector and your property-insurance agent before you install heat in a shop.

Although their simplicity may be tempting, avoid any unvented fuel-burning appliance in the shop. Unvented kerosene heaters in particular don't work well when their wicks become contaminated with wood dust. And when they aren't burning efficiently, kerosene heaters produce carbon monoxide, which can cause health problems even at low concentrations. Lacking a wick, gas burners aren't as sensitive to dust as kerosene heaters. Both types of heaters produce water as a by-product, which means an unvented fuel-burning heater will increase the moisture level in your shop. If the heater stays off in your absence, this moisture is likely to condense, and no doubt will rust the costliest tool in your arsenal.

Buy insulation once, save fuel forever

The first step to heating a shop is matching the insulation level to the climate. Remember, you buy insulation once, but fuel costs go on forever. Do it right. That said, the details of shop insulation are beyond the scope of this article. Your local building code will specify the minimum insulation values for residential construction, and these are a good place to start. You can always add more

insulation than code requires; doing so will increase your comfort and decrease your energy usage. However, it will probably take a long time to recoup the cost of extra insulation if you go far beyond the code requirements.

Air sealing is as important as the R-value (resistance to heat flow) of the insulation. In a drafty cavity, most insulation has an R-value of close to zero. Any breach in the building envelope—a door without weather-stripping, a leaky attic hatch, or a hole in a wall—will cost you heat and money all out of proportion to the hole size. Pay particular attention to the ceiling and the tops of the wall framing. Because warm air rises, you can almost watch the dollar bills floating out of the smallest holes in these areas. Garage doors need close attention as well.

After insulating, figure out how much heat you need. Here's where a knowledgeable supplier can help. Heater size depends on the climate, the size and insulation level of the shop, and how warm you want to be. For example, a two-car garage shop insulated to residential

Fuel for thought

The type of fuel that's most convenient is a big factor in choosing a heater. Fuel prices are volatile, so the discussion of price here, although based on history, is quite general.

NATURAL GAS

Natural gas, piped under city streets, is a good choice, particularly if your house is hooked up already. Gas is usually moderately priced, although it's a commodity, so the price fluctuates with demand. You buy it as you use it, so you can't stockpile fuel in the summer, when prices tend to drop. Because gas burns very cleanly, heater maintenance is minimal. And because it's supplied from a pipeline, you never run out.

PROPANE

Propane burns in the same appliances as natural gas. However, because propane contains more Btu per given volume, it's critical that your heater is set up to burn it. With most heaters, that's a simple matter. Propane is delivered to a tank outside that you either buy or rent from the supplier. It's generally more expensive per Btu than natural gas, and rarely is used where natural gas is available. Filling up at cheaper summer prices can save money. Propane heaters are also low maintenance.

KEROSENE AND FUEL OIL

Kerosene and #1 and #2 fuel oil are readily available in the Northeast and Northwest, less so in other parts of the country. Their cost per Btu has been the cheapest historically. Like propane, they're stored on site in a tank that you own. Prices are often lower in the summer. Unlike gas, kerosene- and oil-burning heaters need a cleaning and a tune-up every year or so, a cost that should be factored in. In more moderate climates, this cost might give gas the edge.

ELECTRICITY

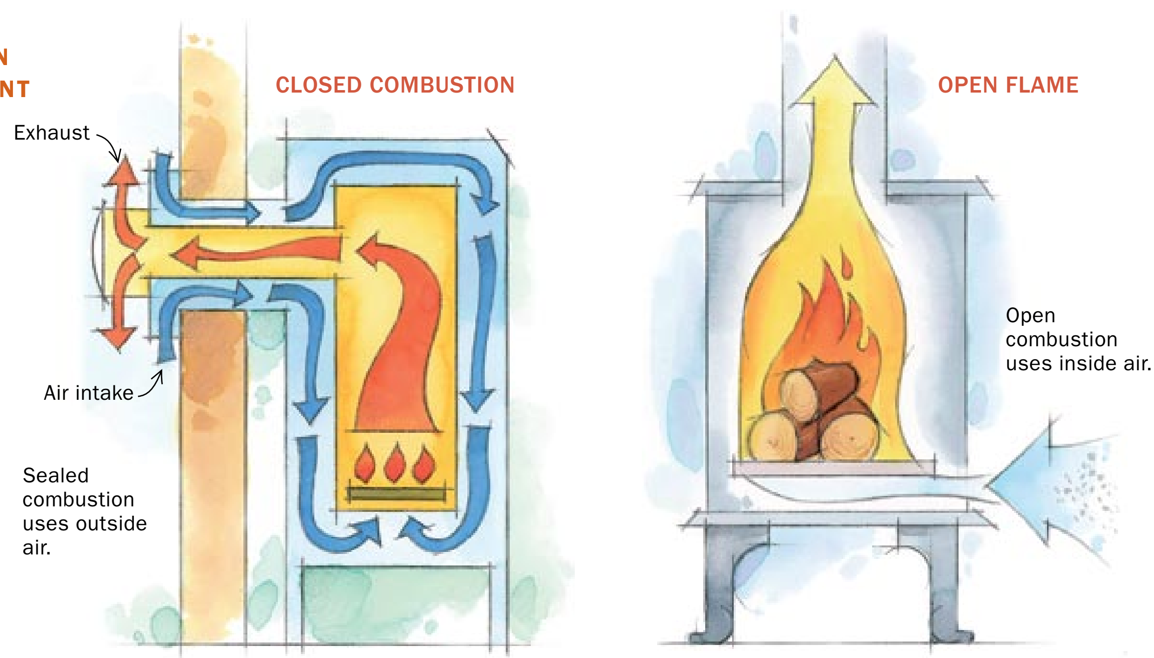
Electricity is simple: Pay the bill every month and it keeps on coming. With no flue or piping to run, electric heaters are cheap to install and don't require regular maintenance. Depending on your electricity rates, however, they can be the most expensive to run.

WOOD

Wood is tempting. After all, most of us have scrap that sure looks like free heat. The amount of wood it takes to get through a winter can be surprising, though. If you spend any serious time in the shop, you likely will need to lay in some cordwood. And if you are not in the shop every day to fire it up, keeping minimal heat going with a woodstove is dicey.

CLOSED COMBUSTION IS SAFE AND EFFICIENT

In a closed-combustion heater, air for combustion is drawn in from the outside, rather than from the heated space. This offers several advantages, the first of which is safety. Because there is no flame exposed to the shop air, the chance of flammable vapors, say from a lacquer-thinner spill, encountering an ignition source is greatly reduced.



standards in southern Connecticut would require about 30,000 Btu of heat per hour on an average winter day.

The downside of an undersize heating system is obvious—you'll be cold. Oversize systems aren't good, either, because they are inconsistent. They kick on at the right temperature, but quickly make it hotter than the thermostat setting, causing big swings in temperature. This is called short cycling, and it's not only uncomfortable, but the constant starts and stops are bad for the equipment's longevity and efficiency. And bigger equipment costs more. Forced to choose between undersizing and oversizing, I'd undersize, and get through the coldest days with a portable electric heater.

Two ways to feel warm: convection vs. radiant heat

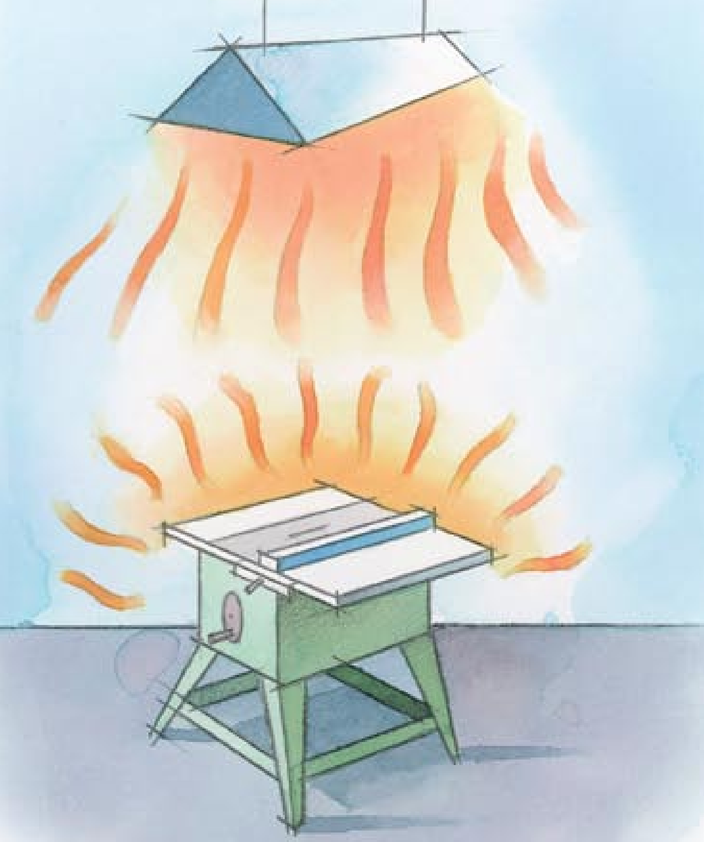
Heat reaches the occupants of a building in one of two main ways: convection, which for this purpose is the movement of warm air; or radiation, the kind of heat you feel when standing next to a campfire. Forced-air heaters work by convection. Most other heaters work mainly by radiation or a combination of the two.

Forced-air heat warms a space quickly, but because it warms the entire space, it might cost more to run. Radiant heaters can be set up to warm specific areas, such as your workbench, leaving the rest of your shop cooler. That said, as the radiant heat warms solid objects such as your bench and tablesaw, they in turn warm the air. The effectiveness of radiant heat varies with the surface area of the radiant source, the temperature of the source, and the distance from the source.

Andy Engel is an energy consultant and woodworker in Connecticut.

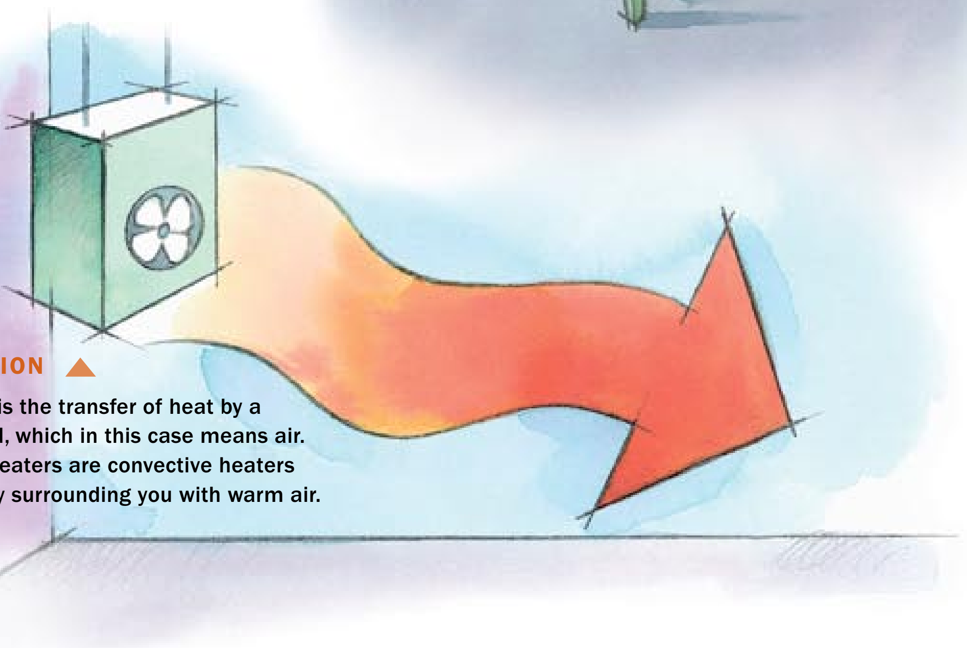
How heat moves

Heat warms a building by radiation and convection. Neither is inherently better, and neither works alone. Convection heaters radiate some heat, and radiant heaters create convective loops.



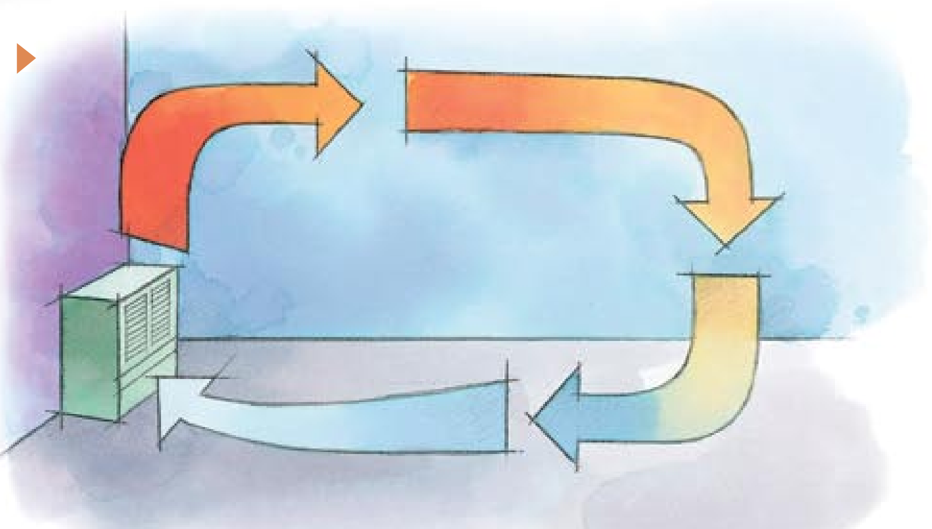
RADIANT HEAT ▶

Radiation is the transfer of heat via electromagnetic waves, such as the infrared waves radiated by a woodstove. Radiation travels through the air, but doesn't warm it much. Rather, it transfers its heat to solid bodies, such as you or your tablesaw. As these solid bodies warm, they will heat the surrounding air, creating some convection. However, most of the warmth you feel from a radiant source is infrared, and has nothing to do with air temperature.



CONVECTION ▲

Convection is the transfer of heat by a moving fluid, which in this case means air. Forced-air heaters are convective heaters that work by surrounding you with warm air.



CONVECTIVE LOOP ▶

As air warmed by a heat source rises, it sucks in cool air from below to replace it, forming a loop of gently moving air. To heat a large area, the heater needs a big surface area, such as a baseboard. Where space is tight, passive radiant heaters may not be the best choice.

A shopper's guide

The heater you choose will be determined by some combination of where you can put it, the fuel, and how the heat moves. Shown here are some common types with their pros, cons, and costs. When considering cost, don't forget installation. An extreme do-it-yourselfer could install any of these heaters, but most of us would hire a pro for at least part of the job.



GAS-FIRED HEATERS

LOCATION: wall, floor
FUEL: natural gas, propane
COMBUSTION: sealed
HEAT TYPE: convection

Most wall heaters are surface mounted, and vent outside through the wall via a horizontal flue. Gravity furnaces are one type: Tall and thin, they suck in cold air from the floor level and vent it out the top. An optional blower can improve airflow. These heaters come in sizes from 10,000 Btu to 50,000 Btu, and cost in the range of $400 to $800.

Counterflow furnaces are similar, except that an internal fan reverses the natural upward flow of heated air within the furnace, blowing warm air out of a louvre near the floor. Priced between $800 and $1,200, these are available up to 65,000 Btu.

Console-type heaters are lower and wider, similar in size to a woodstove, with an output of 20,000 to 70,000 Btu. Their price range is $500 to $900.

Manufacturers include Louisville Tin and Stove Co. (www.cozyheaters.com), Empire Comfort Systems (www.empirecomfort.com), and Rinnai (www.rinnai.us). Major furnace manufacturers such as Trane and York also make counterflow furnaces.



ELECTRIC HEATERS

LOCATION: wall
FUEL: electricity
COMBUSTION: none
HEAT TYPE: radiant, convection

Probably the simplest heater to install and the least expensive to buy is the wall-mount electric heater. There are two types: those that use a fan to force air over electric resistance coils and into the shop, and those that heat by radiation or by creating a natural convective current (think baseboard heat). They're available in small sizes (500 watts) that would easily take the chill off a Florida shop, or in larger units (8,000 watts) that would warm a small Maine shop. The small ones run on 120v, the larger on 240v. Expect to pay as little as $100 for a small heater and as much as $800 for a large one. Installation is relatively simple, requiring mainly a dedicated electrical circuit. The downside is that even the larger models produce only the equivalent of about 24,000 Btu, suitable for a one-car garage in a cold climate. Manufacturers include: TPI Corp. (www.tpicorp.com), Marley Engineered Products (www.marleymeh.com), Cadet (www.cadetco.com), and Empire Comfort (www.empirecomfort.com).

OIL-FIRED HEATERS

LOCATION: wall, floor
FUEL: kerosene, heating oil
COMBUSTION: sealed
HEAT TYPE: convection



Another through-the-wall option is a unit that burns kerosene or stove oil (#1 low-sulphur heating oil). Units that burn #2 home heating oil are available but need more regular maintenance. Oil-fired heaters claim high efficiencies and the lowest cost per Btu but require an outside fuel tank. Outside tanks can be problematic in really cold weather, because cold fuel oil can gel. Additives are available to prevent this problem, but you have to remember to add them. The only wall penetrations are a small hole for the flue and the outside combustion-air intake, and an even smaller hole for the fuel line. Sizes range from 15,000 Btu to 43,000 Btu, prices from $750 to $1,600.

Manufacturers include Monitor Products (www.monitorproducts.com), and Toyotomi (www.toyostove.com).

Photos, this page: Courtesy of Louisville Tin and Stove, Empire Comfort Systems, Toyotomi



FAN-FORCED HEATERS

LOCATION: ceiling
FUEL: multi
COMBUSTION: varies
HEAT TYPE: convection

Options abound with ceiling-mounted heaters. Several manufacturers make fan-forced, gas-fired units that hang from above. The cost hovers around $500, and the Btu range is from 30,000 to 75,000. You'll need to add the cost for the flue and the electric and gas hookup.

Fan-forced hot-water (hydronic) heaters are also available. Because no part of the heater ever gets hotter than the water, there is no fire danger. The downside is the need for a hot-water source. In a shop attached to a house with hot-water heat, you might tap into the existing system. If you go this route, you'll have to keep the shop above freezing or run a special antifreeze through the heating system. These heaters start at around $350, but piping will add to the cost. If you have to add a boiler, the cost will run into the thousands. Sizes range from 18,000 Btu to close to a million Btu. Manufacturers include Modine (www.modine.com), Marley Engineered Products (www.marleymeh.com), Cadet (www.cadetco.com), and Beacon-Morris (www.beacon-morris.com).



INFRARED HEATERS

LOCATION: ceiling
FUEL: gas, electric
COMBUSTION: sealed
HEAT TYPE: radiant

Often called infrared heaters, these are either gas-fired or electric. Smaller units can provide spot heating over a workbench; several can heat an entire shop. By locating one where you usually work, you might leave the rest of the shop at a cooler temperature, saving energy.

The smallest gas-fired model is 25,000 Btu and costs about $650. Be sure to get a model certified for residential use, such as Detroit Radiant's LS or LD series (www.reverberray.com), or Schwank's STR 45-10 (www.schwankheaters.com) if you're heating an attached garage. A downside is this type of heater's high surface temperature. You need at least an 8-ft. ceiling for a gas-fired radiant heater. And you must maintain the clearances to combustible materials specified by the manufacturer.

Because they don't get as hot, electric radiant heaters don't suffer from the same clearance constraints as gas units. One manufacturer, Ennerjoy (www.sshcinc.com), targets the woodshop market by selling panels with slight cosmetic defects for $250 for a 1,000-watt unit, several of which would be required in a northern shop.



WOODSTOVES

LOCATION: floor
FUEL: wood, pellets
COMBUSTION: open
HEAT TYPE: radiant

Woodstoves can be the ultimate in cheap heat, or a nuisance. Because there's always an open flame, the danger of fire never really goes away. Building codes require at least 3 ft. of clearance to combustibles and a non-combustible hearth that extends at least 18 in. from the stove. Stoves require an annual chimney sweeping and regular ash cleanout. A big advantage to a woodworker is that they also get rid of scrap.

But woodstoves can emit substantial particulate matter. Check if your town regulates such emissions before installation. Pellet stoves are a costlier option. A thermostatically controlled hopper feeds cellulose pellets into the stove as needed. Pellets aren't free, but the convenience is a valuable consideration.

HEAT PUMPS

LOCATION: wall
FUEL: electric
COMBUSTION: none
HEAT TYPE: convection

A through-the-wall heat pump is another electrically powered option. Commonly used in hotel rooms, heat pumps work like refrigerators or air conditioners, extracting the heat from the air and moving it somewhere else. The chief advantage of heat pumps is that they can be set to cool the air as well. (The industry name for these units is PTAC, or packaged terminal air conditioner.) They're available in sizes from about 7,000 Btu to 15,000 Btu, and are best suited to moderate climates. For cold weather, many heat pumps have auxiliary electric coils that kick in and produce heat. Costs run from $500 to $1,000. Manufacturers include most major HVAC suppliers.



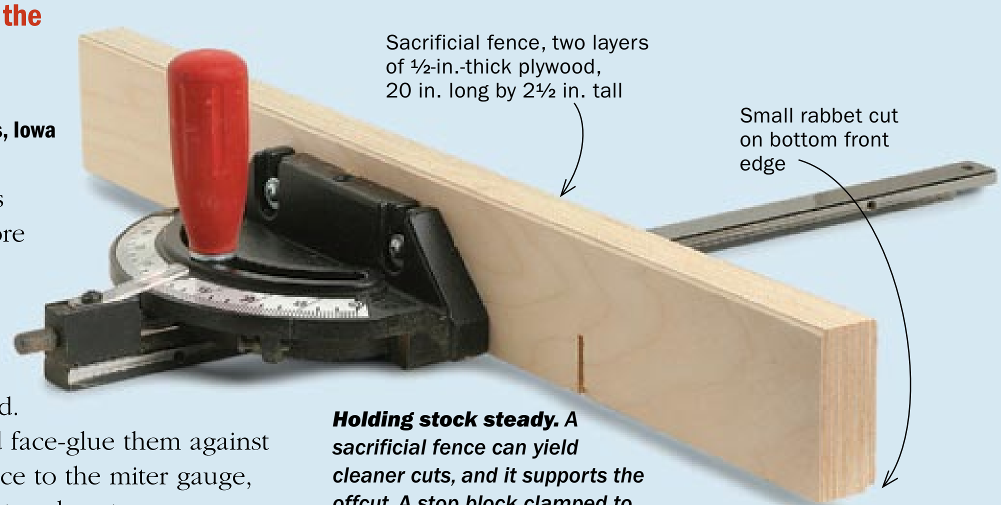
Photos, this page: Courtesy of Empire Comfort Systems, Vermont Castings, Schwank Heaters, Friedrich

Q&A

Shopmade fence for a miter gauge

Q: I often see a long wood fence attached to the miter gauges featured in your articles about tablesaw techniques. Why bother?

—WALLACE WELLS, Des Moines, Iowa



A: A LONG, STRAIGHT SACRIFICIAL FENCE provides better support for workpieces, which yields more precise cuts. It provides a mounting surface for stop blocks or a stop extension stick. And it prevents chipout on the back edge.

To construct a flat, stable fence, start with two ½-in.-thick pieces of hardwood or plywood. Make them about 20 in. long by 2½ in. tall and face-glue them against a flat reference surface. Before securing the fence to the miter gauge, cut a small rabbet in the bottom to give sawdust a place to go.

Mount the fence so that one side can act as a sweep for moving cutoffs past the blade. That means having a few inches of fence extending beyond the blade. To make a nonslip surface, you can glue fine sandpaper to the fence.

Finally, add a stop assembly. There are several versions commercially available for about $20 that can be attached to a wooden fence via a rail. Or, simply use a small wood handscrew or a small block of wood. If you're making repetitive cuts longer than the fence, clamp on a long, thin piece of wood with its own stop block.

—Tim Albers works wood in Ventura, Calif.

Holding stock steady. *A sacrificial fence can yield cleaner cuts, and it supports the offcut. A stop block clamped to the fence allows repetitive cuts.*





Corrosion prevention. *A light coat of paste wax can help prevent tools from rusting.*

Wax keeps rust off hand tools

Q: What should I use to keep hand tools from rusting? I've seen suggestions ranging from paste wax to WD-40 to camellia oil. Do any of those substances work better than good old 40-weight motor oil?

—JERRY MALONE, Pueblo, Colo.

A: IN MY EXPERIENCE, LIGHT RUST ON HAND TOOLS means that the shop is too humid. If you can, keep the shop heated and cooled; at a minimum, run a dehumidifier during the summer.

If climate control isn't practical, coat the metal surfaces of hand tools with a substance that keeps rust away. Paste wax will work. Just buff it to remove the excess, and reapply the wax regularly because it wears away with use. You also can store tools in a canvas tool bag in a room that has reasonable humidity levels. But I wouldn't use camellia oil or motor oil. In my experience, they stain the wood, and I don't like the oily feel when I use the tool.

—Lonnie Bird runs a woodworking school in Dandridge, Tenn. (www.lonniebird.com).

Photos: Staff



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Hanging a heavy tool cabinet



Q: Jan Zoltowski's tool cabinet (pp. 34-41) is impressive, but its sheer size raises a question often overlooked in articles featuring wall-mounted cabinets. How do you properly secure something that must weigh over 300 lb. when filled with tools? The article shows the cabinet secured to the wall with French cleats, with at best four screws on each cleat that is mounted to the wall. What size are the screws, and why not use lag screws for something this heavy?

—SKIP KUNST, Cincinnati, Ohio

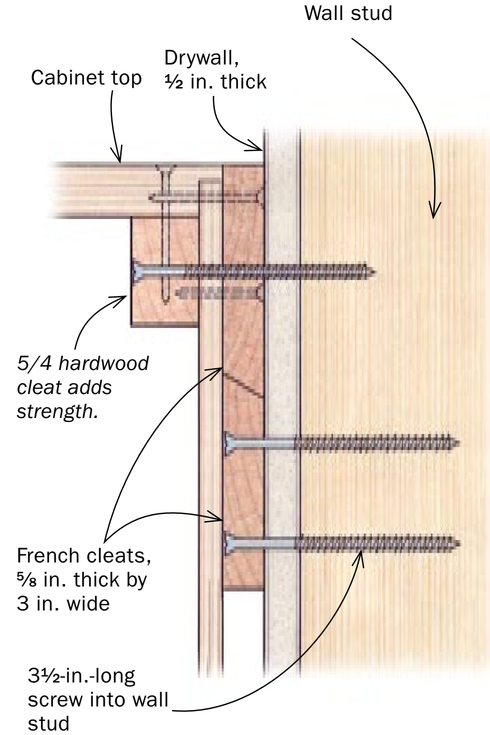
A: I'VE BEEN IN THE CABINET BUSINESS for 36 years and I've never heard of a cabinet falling off a wood stud wall as the result of screw failure.

But I have seen cabinets fall because of their own poor construction, leaving their backs still on the wall.

The screw size depends on the weight the cabinets will carry. Typically, kitchen cabinets are hung with 3½-in. drywall screws, but to be conservative I use 3½-in. #10s. I think lag screws are overkill. Two-thirds of the screw should penetrate the stud.

In my opinion, Mr. Zoltowski's cabinet-mounting system is strong enough. But for extra strength, you might add an internal cleat, then screw through it into the wall studs.

—Joel Wheeler owns a cabinetmaking business in Albuquerque, N.M.



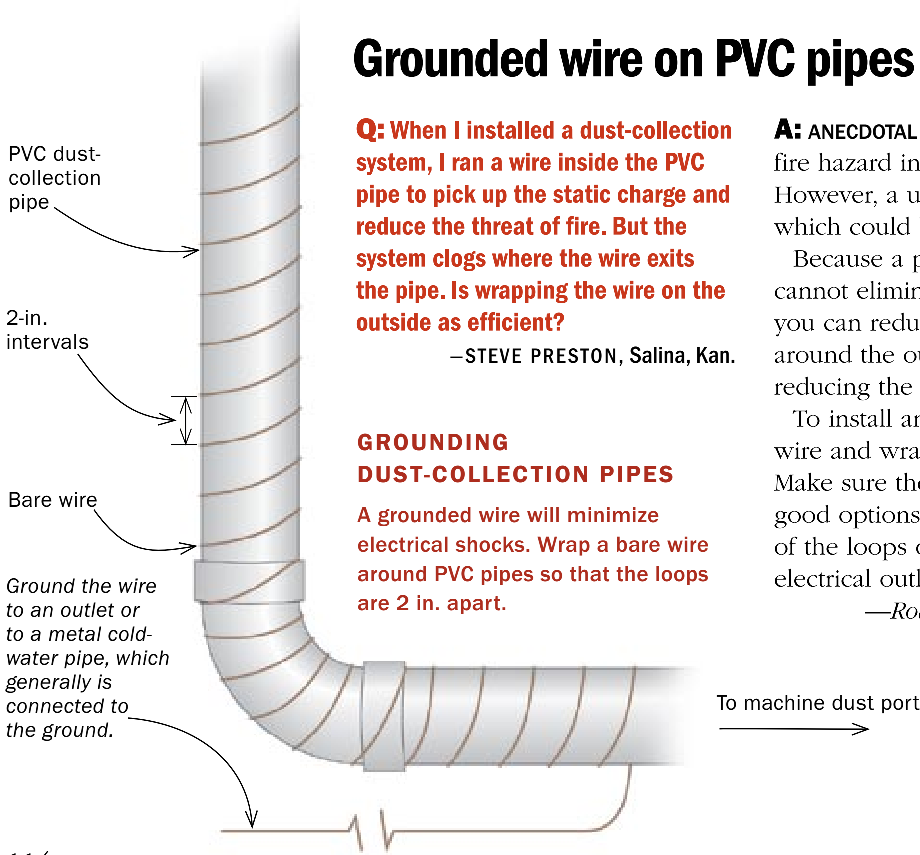
A STRONG CONNECTION

To secure a heavy cabinet to a wall, screw a hardwood cleat inside its top corner. Then drive 3½-in. #10 screws through the cleat into the wall studs.

Grounded wire on PVC pipes reduces electrical shock

Q: When I installed a dust-collection system, I ran a wire inside the PVC pipe to pick up the static charge and reduce the threat of fire. But the system clogs where the wire exits the pipe. Is wrapping the wire on the outside as efficient?

—STEVE PRESTON, Salina, Kan.



GROUNDING DUST-COLLECTION PIPES

A grounded wire will minimize electrical shocks. Wrap a bare wire around PVC pipes so that the loops are 2 in. apart.

A: ANECDOTAL AND SCIENTIFIC EVIDENCE says that static is not a fire hazard in the kind of dust-collection system you describe. However, a user might receive a nasty jolt from such a system, which could be a different sort of hazard.

Because a plastic system cannot really be grounded, you cannot eliminate the chance of the user getting a shock. But you can reduce it. A grounded wire either inside or wrapped around the outside of the pipe is reasonably effective at reducing the chance of shock.

To install an outside ground wire, use any old or new bare wire and wrap it around the pipe so that the loops are snug. Make sure the wire is attached to ground at some point. Two good options are catching a grounded cold-water pipe in one of the loops or connecting the wire to the ground in an electrical outlet.

—Rod Cole is a woodworker and mathematician living in Lexington, Mass.

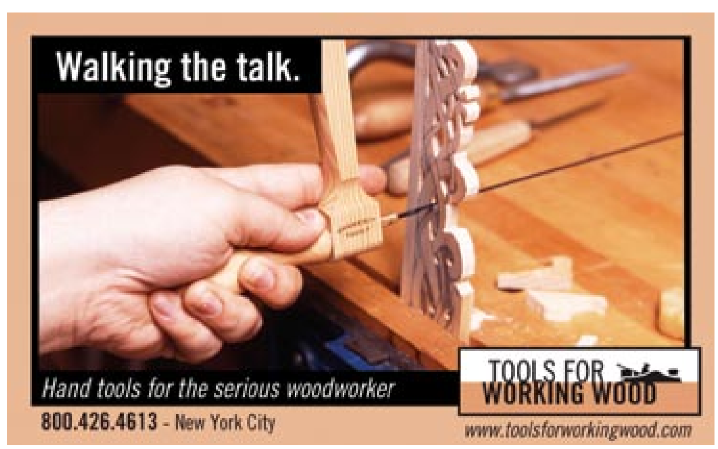
Drawings: Vince Babak (top); Kelly J. Dunton (bottom)


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shop maintenance

BY DAVID L. WISELEY

Conquer clutter

10 STEPS TO KEEPING YOUR SHOP ORGANIZED AND FREE OF JUNK

I used to spend more time looking for tools than using them. One day, as I languished in a mountain of mess, I resolved to overcome my bad habits, which had become a huge obstacle to my productivity. I devised a system that has enabled me to sort my tools and to attack, consolidate, and eliminate junk in my workshop. Today, my shop is a fun place to be; it's clean enough to be healthy and dirty enough to be happy. And when I need a tool, I can find it without having to tunnel through mountains of clutter. Here are the 10 practical methods I used to organize my shop.

1. Organize tools by groups

You don't need a special cubbyhole for every tool. Using large cardboard boxes, about 12 in. by 16 in. by 24 in., I put all related tools in the same labeled box. To store the boxes, I built shelves along the walls of my shop, about 2 ft. down from the ceiling. Then I cut off the box tops to provide easy access to my tools.

2. Apply the Rule of 10

Every time I enter the shop, for whatever reason, I first put 10 things back where they belong. Everything counts. For example, throwing five sockets back into the toolbox counts as five items. Add three chisels and two screwdrivers, and I'm done. In the long run, applying the Rule of 10 will reduce clutter in the shop with seemingly little effort.

3. Relocate commonly used items

For a long time, I kept nails and screws in assorted bags, bottles, and coffee cans under a workbench, where they often were misplaced and easily lost. My solution was to build a fastenings drawer into the bench where I did most of my work. Now I can quickly locate whatever type of fastener I need. By the way, those plastic boxes that have clear tops and about a dozen little compartments inside are great at eliminating clutter in the shop.

4. Throw out junk

A new box of nails costs only $1. So I told myself, "Throw out those old nails you saved when you tore down grandma's back porch!" It is also a good idea to lose those things that have become obsolete, like that old eight-track player lying dead in the corner.

5. Untangle power-tool clutter

Corded power tools are difficult to store neatly. So I decided to forget about trying to be neat. Instead, I made some simple wooden boxes without tops and dedicated one box to each tool, along with any of its little wrenches and keys. I did the same for extension cords, work lights, and other devices.

6. Take out the trash

My shop had only one waste container, and sometimes months would go by without my emptying it. Now I have three 30-gal. waste containers, and they get emptied regularly.



7. Don't save every cutoff

It's hard to toss away wood scraps. I used to make a product that created barrels of 6-in. by 6-in. oak pieces that seemed too good to discard. Then I learned to stop over-valuing my scraps. Now small cutoffs go into the scrap bin or the stove. Pieces shorter than 2 ft. long get shoved into a large wooden box under my bench. Long, narrow stock is stored vertically in a barrel mounted on wheels.

8. Pare down your tool collection

My shop had plenty of screwdrivers, but I could never find one when I needed it. So I laid them out on my benchtop and culled what I really needed. Then I put each screwdriver in its dedicated location and sold the rest. I don't advocate trying to get by on the bare minimum, but rather focusing on getting rid of unneeded tools.

9. Label perishables

Some things last forever. I used to treat everything that way. Did you know that old shellac doesn't dry well? I do now. Today, when I buy a product that has a shelf life, I write a discard date on the can with a laundry marker. Periodically, I go through my cans of paint and finish, eliminating the duplicates and stale items.

10. Let go of surplus

Finally, I picked up every item in my shop, from homemade jigs to exotic woods, and asked myself two questions: Had I used that item in the last five years? Did I have a definite need for it in the next six months? If the answer to both questions was no, I gave the item away. □

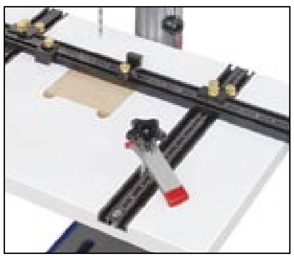
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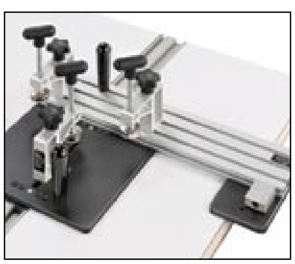


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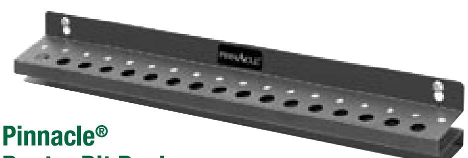
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